INTRODUCTION

TO

THE TABLES

OF

THE FASTI CATHOLICI

BOTH

THE GENERAL AND THE SUPPLEMENTARY.

BY

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ADVERTISEMENT TO THE READER.

THE mean Equinoctial time of the General Tables (Solar Cycle, Division B) requires a correction from first to last; the particulars of which are stated in the Advertisement prefixed to those Tables.

A correction is wanted also for Table XIV of the Supplementary Tables; that of the mean motion of the moon in longitude (ML) in the mean Julian year; the amount of which is $\mp 39'' \times \kappa$: i. e. $\mp 39''$ multiplied by the number of centuries before or after A.D. 1801. This correction is *negative* before A. D. 1801; *positive* after: i. e. it must be subtracted from the mean longitude found by Table XIV before A. D. 1801, and added to the mean longitude found from it, after A.D. 1801.

A correction is also wanted for Table xvii; that of the mean motion of the lunar Perigee (PL) in the mean Julian year; the amount of which is $\mp 31'' \times \kappa$: i.e. $31''$ multiplied by the number of centuries before or after A. D. 1801. And this must be *subtracted* from the mean longitude found from Table xvii (PL) before A. D. 1801, and *added* to it after.

A correction is also required for Table xx; that of the mean longitude of the moon's Ascending Node (NL) in the mean Julian year; of $\mp 63'' \times \kappa$, or $\mp 63''$ multiplied by the number of centuries before or after A. D. 1801. This too must be *subtracted* from NL (found from Table xx) before A. D. 1801, and *added* to it after.

It is recommended also to substitute the following formulæ for the Secular Correction, instead of those which are pro-

posed page 221, 223, and 225 of the Introduction, respectively.

i. Secular Correction of M L = $+ 10''\cdot 526\,03 \times \kappa^2$
$- 0\ \cdot 012\,719\,6 \times \kappa^3$
$- 0\ \cdot 000\,064\,644\,2 \times \kappa^4$

In which κ stands for the number of centuries before or after A. D. 1801: and before A. D. 1801, the second and third terms must both be subtracted from the first; and the remainder must be applied with a positive sign to the mean longitude found from Table xiv, corrected as last directed. After A. D. 1801, the second will become positive, and must be added to the first; and the sum, (diminished by the third term,) must be applied to the mean longitude found from Table xiv (corrected as before) with a positive sign.

ii. Secular Correction of P L = Secular Correction of ML × $-3\cdot 810\,37$.

The sign of this correction is *negative* both before and after A. D. 1801: i. e. it must be subtracted from the mean longitude found from Table xvii, whether before or after A. D. 1801.

iii. Secular Correction of N L = Secular Correction of ML × $+0\cdot 644\,48$.

The sign of this correction is *positive* both before and after A. D. 1801: i. e. it must be added to the mean longitude found from Table xx, whether before or after A. D. 1801.

See Fasti Catholici, vol. iv. Appendix, ch. i. and ii, and ch. v. page 669, 670.

The dates of the three full moons, (page 281, 284, 286 respectively,) when these corrections are taken into account, stand as follows:

B. C.		From midnight. h.	m.	s.				From midnight. h.	m.
721	March 19	21	41	49	Mean time.	Ptolemy,	March 19	21	30
720	March 8	23	56	41	—	—	March 9	0	0
720	Septr. 1	20	24	57	—	—	Septr. 1	20	30

Of these, the recorded date of the first is most to be depended on; and, if that is given by Ptolemy in apparent time, it differs only one minute from the calculated date: the equation of time being ± 11 minutes, or nearly so.

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PART I.

CHAPTER I.

On Æras and Epochs.

SECTION I.—*Definition of the word Æra.*

AN ÆRA is a continuous reckoning of time in some one of its measures. It might be defined a continuous reckoning of time by years; for there is no instance of an æra, either in ancient or modern times, which was not, or is not, actually reckoned in years of some kind or other. Still there is no absolute necessity that this should be the case. A constant reckoning of time in days or weeks or months is as conceivable as one in years; and such a reckoning would be an æra. Something of this kind is actually in existence at the present day in the sexagesimal cycle of the Chinese, of which we shall give an account hereafter; though it does not answer completely to the idea and definition of an æra. The longer measures of time are more comprehensive than the shorter; and as the longest of all the year is the most comprehensive of all: and on that account it is to be preferred for the reckoning of æras. But the shorter the measure in question, the better adapted it would be for exactness; and in particular the shortest of all, which is the cycle of night and day: for there can be no question that, were such a thing as an uninterrupted notation of time in terms of the succession of day and night practicable, it would be the most accurate mode of reckoning it which could be adopted.

Section II.—*Etymon or derivation of the word ÆRA.*

With regard to the derivation or etymology of this word Æra, the English language has borrowed it from the Latin; but it is agreed that, in the sense which has just been explained, it is not a classical term in the Latin language: it is not to be met with in its proper chronological use and acceptation in any Latin writer of standard authority.

The Latin grammarians derive the word æra in their own language from *Æs*, a piece of brass; and generally from *æs* as a piece of brass in the shape of money [a]. Small pieces of brass coin appear to have been employed by the common people among the Romans, to assist them in the ordinary processes of arithmetic; just as ψῆφοι (*calculi* or *pebbles*) were among the Greeks. And hence, through a very natural metonymy, *æra* in the plural, (the sum total, or number of such pieces,) came to be substituted for any sum or number whatsoever. And so far there is classical authority, (or authority only just inferior to classical,) for the use and meaning of the word even in Latin.

But as to the next step, (the most important of all to this particular question of the origin of the word in its chronological sense,) that of the derivation of *æra* in the feminine gender, and in the singular number, from *æra* in the neuter and in the plural; it is liable to many objections. It is not easy on this hypothesis to account for either the gender or the number of the word. Besides which, *æra* as a sum total of any kind, and *æra* in the sense of a continuous reckoning, which from its very nature can never be regarded as total and complete, are not analogous terms. The ideas represented respectively by them are not sufficiently close to each other to be interchanged and substituted one for the other.

Without however entering at any greater length at present into the discussion of this question, (which we hope to have an opportunity of considering in a more appropriate place elsewhere,) it is sufficient to declare the opinion which we ourselves have seen reason to form concerning it: viz. That

[a] Thus Isidore, Origines, v. cap. 36. p. 41: Era (Æra) singulorum annorum constituta est ab Cæsare Augusto, quando primum censum exegit ac Romanum orbem descripsit. dicta autem ab eo quod omnis orbis *es* (*æs*) reddere professus est reipublicæ.

the origin of this particular word, and its application in its proper chronological sense, are to be traced ultimately to the influence of the languages of the north of Europe and of the Latin one on the other, as soon as they had been brought into mutual contact. Even in the most classical Latin authors, (Cæsar, Virgil, Lucan, Pliny the Elder, Suetonius, Tacitus, all of them later than the beginning of the connection between the Romans and the nations of the north,) we meet with many words which must have passed into the Latin from those languages; assuming merely a form and a termination proper for the Latin: such as *mannus* from *man*, *hertha* from *earth*, *bardus* from *bard*, *soldurius* from *soldier*, *beccus* from *beak*, *glæsum* from *glass*: and to mention no more at present, even GALLUS from GAËL. The word *æra* in Latin might be derived by the same method, and after the same analogy, from the vernacular term in these languages, which denotes the *year*. Nothing would be necessary for that purpose but to Latinize the form or termination. Our own word *year*, on this principle, would become *yeara*. And if there is good reason to believe (as we apprehend) that the first letter of this word *year* was originally little more than a breathing, or an affix (common to the languages of the north in general), just as much as the Æolic digamma in the Greek, or the *v* in Latin *; it might easily assume the form of *Eara*, or *Æra*.

* The Latin *ver*, no one can doubt, was originally the same as the Greek ἦρ: and it appears to us exceedingly probable that the Greek ἦρ and the Latin *ver*, (each in the sense of spring,) and the Anglo-Saxon *year*, were originally the same word; the idea of which in the former was always restricted to its proper sense of *spring*, but in the latter was modified so as to have the sense of *year*, from the well understood fact and the general belief among the nations of the north that annual time in particular was properly to be reckoned from *spring*: so that so many *years* were so many *springs*, and *vice versa*, so many *springs* so many *years*; and spring and year in their apprehension (at first at least) were necessarily convertible terms. When they came to reckon annual time at last from the winter solstice, (as they did from the time of the proper correction of the primitive calendar among them,) they began also to use the word *winter* in this secondary sense of *years*; and to reckon so many *years* as so many *winters*. See our Fasti, vol. ii. 110, Diss. ix. ch. iv. sect. xii.

The word for *year* in all these languages bears its own testimony to a common origin, and almost in a common form and shape at first: the old

Of the probability of this explanation we leave our readers to judge for themselves. We will further observe at present only first That, if this is the true account of the origin of the word, nothing could be more consistent with such an origin than its strict chronological sense of a reckoning of time by *years*. Secondly That since it begins to appear in this particular sense first of all in *Spain*, and in connection with the *Æra Hispanica* [b], the introduction of the word into use in its strict chronological acceptation is probably to be traced to Spain: and to judge from the date of the council of Toledo, to which it is found attached, it must be older in Spain itself than A. D. 400 at least [c]. Thirdly That if it was actually derived from such a word as *year*, or any other resembling it in form and sound; it was probably both pronounced and written at first not ÆRA but ERA, with the sound of the ἦτα in Greek, or of the double *ee* in English. The proper pronunciation of *æra* in Latin must have been more like that of the Greek *αι*, (as in *αἶρα*,) than this of the double *ee* in English. It appears, in fact, from the oldest inscriptions extant in Spain in terms of the Æra Hispanica [d], that it must have been written at first *Era*, not *Æra*. Notwithstanding this however, the most classical orthography of the word at present we apprehend to be *æra*, not *era*; for which reason we have fixed upon *Æra*, for the use of our Tables, in preference to *Era*, and propose to adhere to it instead of the other, throughout.

SECTION III.—*Of Epochs, and their relation to Æras.*

An EPOCH (*epocha* or ἐποχὴ) is first and properly an *hesitation* or *stopping* of some kind, a *stopping-place*, or *punctum stans*; and secondarily also a *point of departure*, a *starting point*, or *punctum saliens*. It appears to have been first used in a technical sense by the astronomers of antiquity; to

Saxon *Ger*, or *Jar*; the Anglo-Saxon *Gear*, or *Ger*; the English *Year*; the Gothic *Jer*; the German *Jahr*, *Jar*, *Jaar*; the Swedish *A°r*; the Danish *Aar*; the Irish or Erse *A'r*; and the like. And if it could assume the form of *ar* or *aar*, instead of *jahr*, *jar*, or *jaar*, so might it that of *ear*, or *er*, instead of *year* or *yer*. See the Sprachvergleichendes Wörterbuch der deutschen Sprache von Dr. J. H. Kaltschmidt, Leipzig, 1839.

[b] Scaliger, De Emendatione, Lib. v. 445–450.

[c] Ibid. p. 446 B.

[d] Ibid. 446 C–447 A.

designate the *loci, places* or *positions*, of the heavenly bodies at particular times, *from* which they had occasion to calculate forwards, or *up to* which to calculate backwards. And from the astronomers, in the course of time, it passed to the chronologers.

In the common chronological use of this term it is often confounded with *æra;* and yet it ought to be distinguished from it. An *æra* is a *continuous* reckoning of time in general: an *epoch* is the *point from which* this reckoning sets out. Every such reckoning must have some beginning; and whatsoever that is, it is the *epoch* of the æra: the *punctum stans*, while the reckoning as yet is stationary, i. e. has not yet begun to be summed up or computed; the *punctum saliens* as soon as it begins to be calculated: the point *from* which it sets out, and *to* which it must be referred ever after continually.

And in this relation to its proper æra the epoch is always some *fact* or other; a chronological epoch some historical fact; an astronomical one some physical fact: and commonly too some fact of sufficient importance in itself, and sufficiently discriminated from other facts of like kind before or after it, to designate it as the beginning of a continuous reckoning of time always referrible to itself. Thus the fact of the foundation of the city of Rome served as the epoch of the Æra Romana or Urbis Conditæ, a continuous reckoning ever after of annual time in terms of the age of the city of Rome: that of the first Olympiad, or of the first actual registration of an Olympiad, among the Greeks served as the epoch of the Æra Olympica: the accession of Nabonassar to the throne at Babylon furnished the epoch of the Æra of Nabonassar there: and that of Yezdejerd to the throne of Persia laid the foundation of the Æra Persica in that country: and so in a variety of other cases of æras, which might be enumerated if necessary.

The importance of an event in itself however is no indispensable condition of an epoch. Nothing is necessary but the *actual connection* of an *actual reckoning* of time with that particular event ever after. Or else were the comparative magnitude of *those* events which must serve for epochs, or the intrinsic importance of each in itself, to be taken into

account, before any one could be selected and designated for its proper use and purpose; every one must admit that at present, and among Christian chronologers at least, there ought to be no recognised epoch of time in any of its measures, but one of these two, The fact of Creation, or The fact of Redemption; one of them the foundation of the *Æra Mundana*, the other that of the *Æra Vulgaris*. For what events has human history, or time itself in constant connection with human history, to supply, which, in point of magnitude and importance, could deserve to be compared with either of these?

Section IV.—*On the anomalous character of the Æra Vulgaris.*

And this leads us to observe that, although the natural reckoning of all æras without exception, from their proper epochs, is *forwards*, because the succession of time itself from any assumed point of departure whatsoever is *forwards* also; still it is not indispensable to an æra that it should be reckoned forwards, (at least in terms,) perpetually. Exceptions have been taken to the anomalous character of the Æra Vulgaris; which is divided into the reckoning of *Before Christ*, and the reckoning of *After Christ*, though the reckoning itself is the same. Consequently it is retrograde one way, and progressive the other. And complaints have been made of the inconvenience or inconsistency of reckoning one and the same æra in two such different ways. But there would have been much better ground for complaint, had none of the great Christian facts, (the Nativity, the Passion, the Resurrection, or the Ascension,) in the estimation and judgment of Christian chronologers, appeared to be of so much interest and so much importance in itself, as to deserve to be made the epoch of a proper, continuous reckoning of time before and after itself; in which case the reckoning must be subject to the division and distinction in question. The style of Before Christ, as referred to any one of these events, must be different from the style of After Christ. And as to the alleged inconvenience of this difference of style, in point of fact, and with so many tables always at hand in which both styles are given correctly, it amounts to little or nothing:

and those who find fault with the vulgar reckoning on this account, and yet discover nothing to object to the much more perplexing and inconvenient system of the reckoning of annual time by the classical æra of the Olympiads, or even of the Urbs Condita, to say the least, are not consistent.

And as to the charge of anomaly in the course and succession of the same reckoning, as if proceeding backwards for one half of the reckoning and forwards for the other; in reality the vulgar reckoning proceeds in one direction all along, and as much so in the style of Before Christ, as in that of After Christ. The only difference is that, while the actual course of the æra is proceeding in the same direction perpetually, the nominal direction, that is, the *style* of the æra, goes backwards for half the succession, and forwards for the other. But it does so in the former instance in connection with past time, and in the latter in connection with present or future time; and that is a distinction which is founded in the reason of things, and is defensible in the principle. Present or future time can be reckoned only in one way or order, and that is the order in which it is generated, or destined to be generated and come into existence: and the vulgar æra in the style of After Christ is agreeable to that rule. But past time is not of necessity to be reckoned in one way only; that viz. in which it was generated and came into existence. It is of the nature of finite and complete in itself: and time already finished and concluded may be reckoned in any way we please. Nothing is necessary for that purpose, but some definite and well-understood boundary or point of separation between that part of duration which is thus considered to be complete and finite, and that which still remains to be generated and completed. This point is supplied by the epoch of the Nativity: to which it is just as allowable to refer the whole course and succession of duration from a certain beginning, like that of the Mosaic creation, before it, as the entire course and succession of the same kind up to a certain termination, like that of the end of the world, after it.

CHAPTER II.

Of the Æras included in the Fasti Catholici, and of the Æras omitted in them.

SECTION I.

THE Æras which will be found to be included in our Fasti Catholici, or General Tables of time, are those which either necessarily make a part of our own system of pure and mixed chronology, or are most indispensable to history and to chronology in general. These are the ÆRA MUNDANA, the ÆRA VULGARIS, the ÆRA CYCLICA, the ÆRA OF NABONASSAR, the ÆRA SELEUCIDARUM, the ÆRA OF INDICTION, the ÆRA OF HEJ'RA, the ÆRA PERSICA, the ÆRA GELALÆA, and the ÆRA SINICA OR SINENSIS. Of each of these, as component parts of our Tables, we shall give some account by and by.

There are others however, besides these, though not so generally useful as these, which it might have been desirable to include in a synopsis, (like that of our Fasti,) of almost all the actual forms of the reckoning of mundane time by æras, which have ever existed; could that have been accomplished without such an addition to the bulk and complexity of our Tables, as must have interfered with their convenience and usefulness. Yet some account of these too may be expected from us; and may serve to a certain extent to supply their actual omission in our Tables.

SECTION II.—*The Julian Period.*

It is scarcely proper to give the name of an æra to the Julian Period of Scaliger; as it does not profess to bear date from any known historical or physical fact: and to call it the Æra Juliana would confound it with the Julian æra, properly so denominated, which bears date, or must be supposed to have borne date, from the correction of the calendar by Julius Cæsar.

This Julian Period is the product of three numbers; that of 15, the measure of the Cycle of Indiction, that of 19, the measure of the Metonic Cycle, and that of 28, the measure of the Solar Cycle: all together making up the sum of 7980;

which is consequently the measure of the Julian Period in years. It was proposed by Scaliger, as one which was competent to take in the entire succession of annual time, with which human history could be supposed on any rational grounds of belief to have been connected perpetually from the first: in which also no two years, from the beginning to the end of the period, could exhibit the same characters, derived from the three cycles of which it was composed; and therefore could possibly be confounded together. And the proposition has been received with so much approbation on the part of the learned, that some of the most eminent among them have not hesitated to say Scaliger's well-earned reputation, (especially as a chronologer,) rests at present more on his Julian Period than on any thing else.

We have not considered it advisable to give this period a place in our Tables; not from any disposition to detract from its merits, or to call in question the opinions and judgments of others concerning it, but because with a true Æra Mundana it is not wanted any longer. It is superfluous even for the purpose for which Scaliger proposed it. It is sufficient to advertise our readers that the first year of this period, which could possibly have entered our Tables either on Jan. 1, or on any other day, along with A. M. 1 and B. C. 4004, must have been the 710th: and the first, which could have been found entering them on the same day A. M. 4005 A. D. 1, must have been the 4714th. Whosoever is aware of these two facts can never be at a loss to reduce any year of the Tables, in the Æra Mundana or in the Æra Vulgaris, to the corresponding year of the Julian Period; or any one of the Julian Period to the corresponding one in the Æra Mundana or in the Æra Vulgaris.

It should be observed however, in order to prevent any misapprehension of the use and application which may be made of this period, from the mention of the three cycles of which it is composed; that it neither is, nor ever could have been, any thing but a constant measure of annual time in the sense of Julian, according to a *positive* rule, of which these cycles are only indications or tests and criteria. There is none of these cycles, except that of indiction, which could ever have been perpetually applicable to the same proper use

and purpose, or can be so still. The lunar cycle which enters the period is not competent to serve as the measure of true lunar time in any sense for more than 304 years at the utmost: and as to the cycle of 28 years, it might be perpetually applicable as the measure of hebdomadal time in terms of annual, if the Julian year itself were perpetually applicable as the measure of annual time in particular, but not otherwise: on which point we shall have more to say hereafter[e].

SECTION III.—*The Æra Sabbatica.*

The Æra Sabbatica is a continuous reckoning of annual time by cycles of seven years; and properly speaking of annual time in the sense of the lunar year, as it entered perpetually into the civil calendar of the Jews, either from the date of the Eisodus or from some other not long after it. And in this sense the Æra Sabbatica was a cycle of seven years, reckoned from the first of the seventh month in that calendar to the first of the seventh month perpetually; the seventh or last year of each being *Sabbatic*, that is, devoted to rest or cessation from the tillage of the ground, and from all the usual operations of agriculture.

We have omitted this æra also in our present Tables, first because it properly makes part of the chronology of the Old Testament; i. e. of the other *instrumenta* and *subsidia* which are necessary for the chronological arrangement of the Old Testament: secondly and chiefly because, in fact, we have already laid it before the world, along with the calendar by which it was regulated from B. C. 1511 downwards, in our Prolegomena ad Harmoniam Evangelicam[f]. We do not hesitate to affirm that the truth of the Sabbatic cycle, there exhibited, may be implicitly depended upon. It is the cycle of the Old Testament; and the cycle of the first book of Maccabees; and the cycle of Josephus; as we are able to prove: and down to the date of the destruction of Jerusalem, (A. D. 70,) at least, it was the only recognised and traditionary cycle of the rabbis themselves: though subsequently to that event, (for reasons nevertheless which may be assigned,) they made a change in the order of the years

[e] See our Fasti Catholici, vol. i. 439 sqq. Diss. vi. ch. iii.
[f] Oxonii, e Typographeo Academico, MDCCCXL.

of the cycle, by virtue of which the rabbinical cycle at present differs by one year from this. The Samaritan cycle too is a different thing from this. Notwithstanding these discrepancies, we repeat our assertion that the true Sabbatic cycle and Sabbatic æra of Scripture is the cycle of our Prolegomena: which we deduce indeed from the seventh year after the Eisodus, B. C. 1514, but which, if any one thinks proper, may also be deduced from the 14th year after the Eisodus, B. C. 1507: though from one or other of these years, to be the true succession which it professes to be, it must be deduced.

SECTION IV.—*The Æra Philippi, Æra of Alexander, Æra Bicornis.*

This æra is only a particular modification of the æra of Nabonassar; of which some account will be given in the next chapter. It takes up the 424th year of the latter æra, and carries on the same kind of annual reckoning (i. e. the equable or cyclical) as that, without any difference from it, except in the style of the æra, and in the sum of annual time so generated in this æra, compared with the same thing in the other, up to the same point of time.

The first year of the æra of Philip = the 425th of the æra of Nabonassar; the common epoch of both, when they began to proceed in conjunction, being Thoth 1 Nab. 425 = Nov. 11 B. C. 324 at 18 hours from midnight, according to the primitive rule of the noctidiurnal cycle, Nov. 12 the same year at midnight, according to the Julian. The historical matter of fact which served as the foundation of the æra was the succession of Philip Aridæus, (half-brother of Alexander the Great,) to Alexander; the date of whose death, (as we hope in due time to demonstrate by means of the Macedonian calendar itself,) was June 13th, B. C. 323, and, in the style of the æra of Nabonassar, Pharmuthi 4, Nab. 425. The current year of this æra, (i. e. Nab. 425,) would not expire till Nov. 11 B.C. 323. And as the reckoning of a new æra, concurrently with this of Nabonassar, could not begin nor proceed from the middle of the current year, it was set back to the beginning of this year, dated as above, Thoth 1 Nab. 425, Nov. 11 at 18 hours, or Nov. 12 at midnight, B. C.

324. Not that this was actually done at the time, which is more than we have any authority to say; only that it was as good as done, and must be supposed to have been virtually done, to account for the reckoning of the æra itself ever after. It is an æra of frequent use among the astronomers (the Greek, as well as the Arabian) and the historians or chronologers of the East. The name (which is also given it) of the Æra of Alexander, (though given likewise to a different one from this,) if referred to the death of Alexander, would be just as applicable to it as that of the Æra of Philip.

Section V.—*The Æra Græcorum: Æra Rumæa, properly so called.*

This æra is a continuous reckoning in Julian years, bearing date one year later than the Æra Seleucidarum which is incorporated in our Tables; though on the same day of the month, as assumed by us, October 1 B. C. 311. It is easy therefore to accommodate the scheme of the Æra Seleucidarum, such as we exhibit, to that of this æra, merely by lowering every year in the former one number. As an æra of actual occurrence, this æra is well attested both by ancient coins and inscriptions, and chronica of various kinds, and also by the usage and style of modern oriental writers. But it seems to have been brought into existence at first under peculiar circumstances, which we hope to have an opportunity of explaining on a future occasion.

Section VI.—*The Æra Juliana.*

A continuous reckoning of annual time in strictly Julian years, or years which may be supposed to be such, from the date of the correction of the Roman calendar by the Dictator Julius Cæsar; one instance at least of the use of which appears in a writer of classical authority on subjects of chronology, viz. Censorinus, De Die Natali, xxi.

This æra consequently must be considered to bear date from the kalendæ Januariæ, or first of January in the proper Roman style, perpetually. And though it is generally taken for granted by modern chronologers, that the kalends of January from the date of the correction downwards, (with only a slight and accidental interruption, soon discovered and

soon corrected,) were always the same as the first of January; this is and always has been a great misapprehension of the real state of the case. The Roman calendar was corrected by Cæsar in B. C. 46; and the first kalendæ Januariæ, or those of the first Julian year, were attached to December 30 B. C. 46, not to January 1 B. C. 45. To determine on what day they fell for 270 years after successively requires a long and minute and laborious investigation. Suffice it to say that, though the kalends of January did often coincide with Jan. 1 in the intermediate period of time, they never did so permanently before A. D. 225; the 270th year in the Æra Juliana itself. From that time forward, as long as the Roman style of the calendar itself continued in actual use, there never was any difference between the kalends of January in the Roman style, and January 1 in the common Julian one of chronology: but until then that was by no means the case.

Section VII.—*The Æra Hispanica.*

A continuous reckoning of annual time in Julian years also; the epoch of which is commonly assumed as January 1 B. C. 38; though doubts have been raised on this point, as if the date of the æra were more properly one year earlier, B. C. 39. Chronologers however in general have long been agreed that, if you subtract 38 from a current date in terms of this æra, it will give you the corresponding date in the æra vulgaris: so that the reckoning of this æra *de facto*, if not the style, must be considered to proceed from B. C. 38. There is no date of the æra indeed extant, which goes back beyond A. D. 1. The earliest known to Scaliger was the date of the council of Toledo; in terms of this æra, the 438th: from which 38 being subtracted, according to the rule, it leaves A. D. 400, the known date of this council in terms of the æra vulgaris. The name of this æra implies that it must have been most characteristic of Spain: from which fact too it would be an obvious inference that, in all probability, it took its rise in Spain. It is the more interesting on another account, viz. that, as we have already had occasion to observe, this æra and the chronological sense and meaning of the word æra itself very probably came into

existence together. But the origin of the æra is still an obscure and uncertain point: and we may possibly find a more convenient time and place for inquiring into it hereafter.

Section VIII.—*The Æra Augusta or Augustana; Æra Actiaca.*

This too is a continuous reckoning of annual time, in the form of the equable year, that is, the year of 365 days and nights perpetually; not in that of the Julian. It is dated from the reduction of Egypt by Augustus, (at that time indeed only Cæsar Octavianus,) B. C. 30: and from the first day of the first Egyptian month, (Thoth,) in that year, August 30 at 18 hours, or August 31 at midnight. It takes up the 294th of the æra of Philip, and the 718th of the æra of Nabonassar. All three met together on the 1st of Thoth, Aug. 30 at 18 hours or Aug. 31 at midnight, B. C. 30: and all three proceeded together *pari passu* ever after*.

Section IX.—*The Æra of Diocletian; Æra of Martyrs.*

A continuous reckoning of annual time in Julian years, but in the proper style of the Julian calendar of Egypt, which was anciently called the Alexandrine, and is represented at present by the Coptic[g]. The first day of this æra was consequently the first of the Alexandrine Thoth, A. D. 284, which coincided with Aug. 29: and as it happened that the elevation of Diocletian to the purple took place only a few days later, i. e. Sept. 17 the same year; this seems to have been the reason why the æra itself came to acquire the name of the æra of Diocletian. It is known also by the name of the Æra of Martyrs; because the great persecution in the reign of Diocletian fell out only 19 years later than the beginning of the æra: i. e. A. D. 303.

But, in our opinion, neither of these denominations could have been given to this æra at first. It came into being

* There was a Julian form of this æra also, of the origin of which we have given an account in our Fasti Catholici, vol. iv. p. 475. Diss. xix. ch. i. sect. iv.

g See our Fasti Catholici, vol. iv. 461. sqq. Diss. xix.

long before the latter of these facts had yet happened; and long enough before the other too, to have been entirely independent of any reference even to that; at least from the first. Nor is either of them competent to explain the connection of this æra with Christian or ecclesiastical chronology in particular, which is something peculiar to it. This connection is ultimately resolvable into a matter of fact, which has been hitherto overlooked, if not altogether unknown; viz. that Aug. 29 A. D. 284 was the date of the first introduction into the Alexandrine church of the Metonic cycle for the regulation of the proper ecclesiastical calendar; and consequently the first introduction of the proper Alexandrine paschal rule. Its connection with the rule for the observance of Easter was necessary, and must have been contemplated from the first. Its connection with the accession of Diocletian, or with the persecution of the church in his reign, could not have been foreseen, nor therefore have been intended at first. It must have been accidental.

SECTION X.—*The Æra of Maherat.*

This æra is peculiar to Abyssinia. It is a continuous reckoning of annual time, first in the equable calendar of that country, afterwards, and at present, in the Julian. The meaning of the name which has been given it is The Æra "of Grace": and (as the denomination itself is almost sufficient to prove) it turns out on inquiry that it borrowed this peculiar designation from a matter of fact, (which it was also intended to commemorate,) the most likely of all to give occasion to such an appellation: viz. the conversion of the Abyssinians to Christianity, and the ordination of the Evangelist of that country, Frumentius, by Athanasius to be their first Patriarch or Abunah.

It is demonstrable that the true date of this æra is A. D. 340: though the Abyssinians themselves reckoned it currently, in times past, as if from A. D. 348; and at this very time, according to Bruce, they reckon it as if from A. D. 1348: the reason being that, when the first thousand years from the epoch had been accumulated, (which would be the case in A. D. 1348,) they were cast off, and a new reckoning of another thousand was begun from the point

where they ended. The Abyssinian calendar at present is Julian; and has been so ever since A. D. 1436: and the years of the æra, we apprehend, are reckoned from the first of Mascaram, (the first month in their calendar,) the Julian date of which is August 29 perpetually.

SECTION XI.—*The Æra Haicana; Æra Armenorum, or Armeniaca.*

This æra is peculiar to Armenia; and takes its name from Haïc or Haïk, the supposed founder of the nation and kingdom of the Armenians. It is a continuous reckoning of annual time in Julian years, the epoch of which is commonly assumed as July 9 A.D. 552, the date of the council of Tiben in Armenia; at which the Armenian church confirmed the condemnation of the council of Chalcedon, which they had once before pronounced; (viz. A. D. 536, at the council of Thevis;) and so consummated their schism, as it is called, or separation from the rest of the church. This day is further characterised as the feria 3ª, or Tuesday; as July 9 A. D. 552 actually was.

No correction however or modification of the Armenian calendar itself, so far as we know, bears date from this day July 9, or in this year, A. D. 552. The equable calendar, (still current among the Armenians as late as A. D. 1710,) could be attached to no fixed date: and as to their proper Julian calendar, which is also their ecclesiastical calendar, and regulates the festivals and observances of their church, it is attached to August 11 in the common years, and to August 12 in the leap-years of its proper cycle[h].

It is generally laid down as a rule that, if you add 551 to the current year of this Æra Haicana, you will get the corresponding year of the Æra Vulgaris; and conversely, if you subtract 551 from a given year of the Æra Vulgaris, after A. D. 552, you will obtain the corresponding year of this Armenian æra.

There is also in use among the Armenians (if not in their own country yet in certain parts of the east where they have settled, and where they carry on the business of traders and merchants) an æra attributed to one Azarias, and connected

[h] See our Fasti Catholici, vol. i. 679. Diss. viii. App. ch. i. sect. iii. art. iv.

with a correction or reform of the calendar also, the date of which seems to have been only two or three years later than that of the Gelalæan correction among the Persians, A.D. 1079; and the idea of which appears to have been suggested to its author, whosoever he was, by this Persian correction itself. It proceeds in the period of 532 years; and, when one of these has been accumulated, it is cast off, and another is begun. At present the reckoning of the æra is in the second period of this description. But there is no necessity at this stage of our work to enter on any further or more complete account of such particulars as these; which are more properly to be reserved for the explanation of their respective calendars.

SECTION XII.—*The Æra Olympica, and the Æra Romana or Urbis Conditæ.*

These æras too will not be found incorporated in our present Tables; and yet they would seem to be much too important, and much too indispensable to classical chronology both Grecian and Roman, to have been omitted. But the truth is that we have purposely reserved them for Tables of their own; one of which is intended to accompany the Hellenic and the other the Roman calendar: if we are permitted to treat of each of these in its turn, and to give each of them *in extenso* to the world.

Our readers may possibly be surprised to learn that the Æra Olympica was a strictly Julian æra, i. e. a continuous reckoning of annual time by Julian cycles of leap-years; that the Olympic cycle itself was this cycle of leap-year; and the Olympic *feriæ* themselves were the six last days, or six epagomenæ, of the Julian leap-year. The date of the æra goes back as far as the institution of the Olympic games by Pelops, Æra Cyc. 2747, A. M. 2745, B. C. 1260: its historical date, that of the Olympiad of Corœbus, A. M. 3229 B. C. 776, was in reality that of the 122d Olympiad from the epoch.

It was attached by Pelops to a fixed Julian term, June 25, which in the year of the institution coincided with the first of the cyclical Epagomenæ; and the six Olympic feriæ were the six days from June 25 inclusive to June 30 inclusive,

i. e. from the first of the cyclical Epagomenæ to the first of the cyclical Thoth in the year of the institution, both inclusive. And these Julian terms, (which were so constituted by Pelops, and by the rule of the observance, at first,) continued to be the stated dates of the Olympic feriæ from the time of Pelops to that of Solon. When the lunar correction of Solon was introduced into use, viz. B. C. 592, this fixed term of June 25 was found to be coinciding with the 11th of the Attic lunar month Skirrhophorion, and of the Elean lunar month Parthenius. And, as that correction had been adopted by the Eleans from the first, the six Olympic feriæ were attached to the six lunar terms from the 11th to the 16th of the lunar month, which were thus coinciding at the time with the same solar and Julian terms as at first; viz. June 25 to June 30. And, by virtue of this original appointment of the Eleans, they remained ever after attached to these same six lunar dates, (as the learned have always been aware, though the reason why they were so has never yet been explained by any one,) sometimes in the Elean month Parthenius, (answering to the Attic Skirrhophorion,) sometimes in the month Apollonius, (corresponding to Hecatombæon,) and, before the introduction of the Metonic correction, sometimes even in a third Elean month, the name of which at present is unknown, (though it may possibly still come to light,) and of which we can predicate no more with confidence, than that it answered to the Attic Metageitnion.

With regard to the Æra Romana, or Urbis Conditæ, as its name implies, it ought strictly to bear date from the anniversary of the foundation, the Roman Palilia or Parilia, April 20 in the Roman style before the correction of Cæsar, April 21 after it: and in the Fasti Consulares, Triumphales, et Censorii, (a large part of which is still extant,) the years of the city are reckoned from this epoch perpetually. In the Varronian reckoning of the æra, and in the commonly received one, they are supposed to bear date from the Kalends of January, or at least from the Consular Ingress, or beginning of the official year: which is not known ever to have coincided with the Palilia, yet is known to have anticipated upon it sometimes as much as four months, and seldom less than one month.

As to the foundation itself, there are three principal dates of that event. The Varronian, B. C. 753, ex Palilibus: the Capitoline, B. C. 752, ex Palilibus: and the Polybian, B. C. 750, ex Palilibus; all which we trust will be seen hereafter to be incorporated in our Tables. But the true date among these turns out to be the Polybian; and April 20 Roman that year, (U. C. 1 of the true Urban notation, U. C. 3 of the Capitoline, U.C. 4 of the Varronian,) the traditionary date of the foundation, turns out to have been the Julian April 24, B. C. 750.

Section XIII.—*General observations on the Æras of antiquity.*

Æras, it might have been conjectured *a priori*, would be found connected in repeated instances with reforms or corrections of the calendar; especially with those of the Primitive Calendar. Yet there is no clear and unquestionable proof to be met with of any such connection, before the time of Yezdejerd among the Persians, A. D. 632, or that of the Sultan Gelâlodîn, A. D. 1079, unless it be in the case of the Japanese correction, of the date of B.C. 660, or in that of the Siamese, B. C. 545. The Egyptians had a Phœnix period, older than the Sothiacal; and a Sothiacal period older than their Apis cycle; and an Apis cycle of great antiquity also: yet whether they had a Phœnix, a Sothiacal, or an Apis æra respectively, we do not know for certain; though we may consider it probable that they had. What was more to be expected beforehand, than that the Julian correction at Rome should have given rise to a Julian æra there in particular? Yet Censorinus is the only Roman writer, in whom an allusion to it occurs; and in him too only twice[1], and in such a manner as plainly implies that nothing of the kind was recognised or used at Rome, by authority at least. Æras are by far the most numerous among the Hindus, and other nations in that part of the world. And yet it is difficult to connect their peculiar modes of the reckoning of annual time in such instances, in their origin and first conception, with corrections of the calendar also; though some there are, and of great antiquity among them, which appear to have been so connected from the first.

[1] De Die Natali, xxi.; cf. xx.

The modifications and changes, introduced at different times into the Primitive Calendar itself, necessarily entailed in some instances the reckoning of annual time ever after in fixed and determinate periods of a certain kind; and so far may be said to have given rise to æras. The nundinal correction of ancient Italy was connected with a period of 110 equable years; which we have seen every reason to conclude was the same as the Etruscan sæculum. The Greeks had an octaëteric æra, dated from various epochs, yet reckoned in each instance by the same kind of rule; and many centuries older than the lunar correction of Solon. They had also a 59 years' cycle of great antiquity; the reckoning or registration of which appears to have been accurately kept down to a very late date. The nations of the north of Europe had a 30 years' period, which constituted their sæculum; and was carefully and exactly reckoned also. The nations of Spanish America had one period of 52 years, and another of 104, and a third of 312; all connected with the correction of the Primitive Calendar among them at first, and all accurately reckoned ever after [k].

Besides these, there was one form of the correction of the Primitive Calendar, the most generally adopted of all, to which we have seen reason to give the name of the Cyclico-Julian, because of its combining the characteristic properties both of the equable and of the Julian year [k]. It was of the essence of this correction to entail the necessity of keeping a strict and exact reckoning of annual time ever after, in periods of 120 Julian years. Nor can there be any doubt that such a reckoning in repeated instances was kept accordingly. The history of these corrections is demonstrative of that fact. And yet by what means this was effected; what helps or contrivances were made use of for the purpose; by what kind of management and superintendance the calendar was constantly so administered, as to be always in appearance cyclical, and yet in reality Julian; who had the charge of it; or how it came to pass that distinct and independent communities, acting each for themselves and without any understanding with the rest, should yet have agreed to regulate their proper calendars on the same principle, and to

[k] See our Fasti Catholici, Diss. vii. vol. i. 542 sqq.

apply the same corrections to them, and at the same time, as often as they were required: these are very curious questions, but withal very difficult to answer. And yet the fact of such coincidences, both in the principle and in the details of the administration of the calendar, is not to be called in question. It is ascertained by a species of evidence of the most unexceptionable kind.

If chance then did not produce such coincidences, design must have done so: and if they were the effect of design then the ancients were adequate to the practical solution even of a problem like this, of reconciling the characteristic properties of the cyclical and the Julian reckoning of annual time one to the other: which at first sight looks like an inconsistency. They knew how to regulate the calendar both on the equable and on the Julian principle, in conjunction; and they not only knew how to do that, but they actually did it, on a very general scale and in repeated instances. Whatsoever errors might creep into their reckoning of time in other respects, it does not appear that they were ever mistaken in the Julian periods of their respective calendars, or ever either forestalled or postponed the proper correction according to the proper rule, except as the consequence of some inevitable necessity *ab extra;* like that for example which affected the Persian calendar, (viz. the dissolution of the first Persian empire,) and led to the interruption of the Gjemschid rule of administration for 600 years and upwards, until it was restored under the second empire.

CHAPTER III.

On the structure, division, and details of the Fasti Catholici.

It has been found convenient to arrange our General Tables or Fasti Catholici in a certain number of divisions (*cancelli* or *laterculi*); eleven of which enter them accordingly, from first to last: which we have discriminated asunder by the letters of the alphabet from A to L. Of each of these we shall proceed to give a summary account; i. e. to explain in brief what there is peculiar to it in contradistinction to the rest.

i.—*First division of the Fasti, or division* A: *Æra Mundana et Vulgaris.*

SECTION I.

The first of these divisions is denoted by the letter A. It comprehends the Æra Mundana and the Æra Vulgaris. The Æra Mundana of these Tables is a continuous reckoning of annual time in mean natural or tropical years, every four of which are supposed to be the same as every four mean or actual Julian years. The epoch of this æra is the first day of the Mosaic creation, the first day of the Hexaëmeron of Holy Writ, the first mean vernal equinox in the tropical year, the *feria prima* at midnight in the hebdomadal reckoning of noctidiurnal time, and April 25 at midnight for the meridian of the Tables, in the annual and noctidiurnal reckoning conjointly according to the Julian rule, A. M. 1 B. C. 4004.

Its proper Julian epoch, according to the reckoning of annual time in terms of Julian at present, would be January 1, the feria sexta at midmight, the same year; and consequently 114 days, from midnight to midnight, in anticipation of its true date. The sum total of this æra, comprehended in our Tables, is 6004.

The Æra Vulgaris (whether B. C. or A. D.) in contradistinction to the former may be considered a continuous reckoning of annual time, from the same epoch as the Æra Mundana but in actual Julian years; that is, years of 365 mean days and nights every three years in order, and of 366 every fourth: referred however perpetually to the event of the Nativity, and consequently enunciated in the style of Before Christ down to the time of that event, in that of After Christ or A. D. after it.

Nothing, as we have already observed[1], is necessarily fixed in the reckoning of this æra, but the epoch *to* which, and the epoch *from* which, it is to be supposed to proceed perpetually. With regard to the former, so far as concerns its fitness to answer the purpose intended by it, it is indifferent whether it is the true date of the Nativity or not. If it is the *assumed* date, and the *generally recognised* date; if it is

[1] Page 5, 6.

well known and understood in itself; then, for all practical uses and purposes, it is competent to stand instead even of the true. The vulgar date of the Nativity, or A. D. 1 answering to A. M. 4005, was determined and laid down by the chronologers of the time, on what appeared to them, no doubt, to be sufficient grounds; though it differs in reality from the true date in the Æra Mundana by *four* years in *excess:* and the person, who is commonly supposed to have introduced it and given it currency first of all, is Dionysius surnamed Exiguus, a Christian monk and a learned chronologer who flourished in the reign of the emperor Justinian, *cir.* A. D. 525.

It would answer no useful purpose to disturb the epoch of the vulgar reckoning, which has so long been in possession of all chronological Tables. It is enough that we know the amount of correction, necessary to reduce it to the truth; and that we can apply that correction to it whensoever we please. The first year of the Æra Vulgaris therefore, after Christ, in our Tables is the usual one, A. D. 1: the first of the same æra, in the style of Before Christ, is the most remote from that of which the nature of the case admitted; viz. B. C. 4004 = A. M. 1. And this æra in particular, as we have already explained, in both its styles is to be considered as properly Julian perpetually; but Julian in the sense of the actual Julian year, defined as above and reckoned either from the mean vernal equinox in terms of the Julian year, like the Æra Mundana, or from January 1: and in either case, according to the proper Julian rule of the noctidiurnal cycle, from midnight.

SECTION II.—*On the astronomical and the chronological rule of reckoning the years of the Æra Vulgaris.*

The Æra Vulgaris, in the style of Before Christ, or B. C., as it may be seen in the Tables, begins with the Æra Mundana; and goes on along with that, decreasing in the same proportion as that increases, (i. e. by one number every year,) down to B. C. 4 in the former, and to A. M. 4001 in the latter, (which is the true date of the event of the Nativity in the vulgar reckoning of annual Julian time, and in the Æra Mundana or annual reckoning of mean tropical

time, respectively): and so on down to A. D. 1 in one of these reckonings, and A. M. 4005 in the other, the assumed or positive date of the same event in each of these æras respectively. At this point of time consequently both the style of the Æra Vulgaris, and the mode in which it proceeds apparently, of necessity undergo a change: and both this and the Æra Mundana, from this time forward, begin to go on in conjunction, increasing in the same proportion, one number every year, alike.

It is evident therefore that, in undergoing this transition from the style of B. C. to that of A. D. or After Christ at this moment of time, the Æra Vulgaris must be passing through the point of zero or 0; and it has been made a question where that point ought to be considered to reside: whether in the *last* year of the reckoning Before Christ, or in the *first* year of the reckoning After Christ? The truth however is that it cannot be supposed to reside in either of these years, more than in the other; and that if it is to be found any where, it must be critically between the two. But such questions as this are more curious than useful. It is certain that, notwithstanding this change of style in passing from B. C. 2 to A. D. 2, there is the same real difference between B. C. 1 and A. D. 1, as between B. C. 2 and B. C. 1, or A. D. 1 and A. D. 2.

Whether indeed, for the sake of convenience and in order to facilitate the reduction of the style of the Æra Vulgaris before Christ to that of the same æra after Christ, it might be desirable to treat B. C. 1 as = 0, is another question. Among the astronomers it is very generally agreed so to treat it*: so much so that it may be considered the proper astronomical rule of the reckoning of the Æra Vulgaris before Christ to refer every term in that æra to the point of zero or 0. And it is necessary to be aware of this rule, which astronomers do not always explain beforehand; and that, in the proper astronomical reckoning of the years be-

* The first astronomical writer, who adopted and recommended this rule, appears to have been Dominic Cassini, (Cassini the elder,) in his Elements of Astronomy. See Halma's Ptolemy, vol. iii.: Memoir of Mr. Ideler, entitled "Recherches Historiques sur les Observations Astronomiques des Anciens," pag. 8.

fore Christ, there is no such number, (in terms at least,) as B. C. 1, i. e. as the chronological B. C. 1: the consequence of which is that, while there is no *real* difference between the astronomical and the chronological reckoning of the æra respectively, there is a *nominal* one; and the former invariably ranges in terms *one* year lower than the latter. Thus in Pingré's Tables of eclipses the series begins nominally in B. C. 1000, yet really in B. C. 1001; because B. C. 1 is assumed to be=0. Chronologers however have not yet adopted this rule: nor have we adopted it in our Tables. The sum of the Æra Vulgaris, which enters our Tables, like that of the Æra Mundana is 6004.

Nothing more however can require to be said in explanation of this æra, or of the Æra Mundana, except that, so far as each of them is to be considered as a Julian æra perpetually, the cycle of leap-year must be considered necessary to each of them also perpetually. The same serves for both: and we define and point it out in the Tabular reckoning of each by the *asterisk*, prefixed to the proper years of the Æra Mundana in particular. The sum total of these cycles in both æras is 1501.

The first of the kind, it will be seen, is a cycle of *three* years and not of *four*; and yet it must be considered a *perfect* cycle; and what is more, it *was* a *perfect* cycle of its kind, as much as any which ever came after it: though in what manner this was effected, cannot be explained at present; but it is explained and cleared up elsewhere[m]. In reality, whatsoever appearance of anomaly or inconsistency in the succession of the cycle of leap-year, in either of these æras, from first to last may be produced by this distinction; it vanishes as soon as it is understood that the first cycle of this kind is to be considered to have borne date virtually from B. C. 4005, one year before the beginning of the Æra Mundana of the Tables itself. We have accordingly commenced the reckoning of the cycle of leap-year in our Fasti as if from B. C. 4005, not from B. C. 4004: though, with a view to intimate that this year was only virtually and not actually the epoch of the cycle, we have cut off this year,

[m] Fasti Catholici, vol. ii. 35 sqq. Diss. ix. ch. ii. cf. also p. 267 note. Diss. x. ch. ix. sect. vi.

B. C. 4005, from the rest of the years which enter the same column in division A, by a line drawn beneath it.

ii.—*Second division of the Fasti, or division* B. *Solar Cycle of the Tables.*

SECTION I.

The second division is marked with the letter B. It comprehends the Solar Cycle of the Tables. In the ordinary acceptation of this term, the solar cycle would designate merely the cycle of 28 years, the cycle of the Dominical or Sunday letter, in the Julian reckoning of noctidiurnal and annual time in conjunction with hebdomadal perpetually. But, as incorporated in our Fasti, and as denoted by this name therein, the Solar Cycle is the cycle of mean natural vernal ingresses, without interruption, from the first of the kind to the last. It is the course and succession of mean natural vernal equinoxes perpetually.

There is no true nor absolute measure of annual time, considered as a distinct and independent, yet integral and complete, measure of its kind, (especially from the first,) but the natural or tropical year. All measures of annual time except this are conventional and positive. None has any right or title to the estimation and name of a constitution or appointment of nature, but this. All others too, as distinct from this, are or should be merely representatives of this, and substitutes for this; all at least, which profess to be actual measures of annual time, as something complete and distinct in itself perpetually, as well as this. They can be so only by answering to this, and by representing it perpetually.

The standard of the mean natural or tropical year, assumed in our Tables, is 365 days, 5 hours, 48 minutes, 50 seconds, 24 thirds of mean solar time perpetually; i. e. 365 d. 5 h. 48 m. 50·4 sec. or 365·24225 mean solar days: a standard distinguished by many remarkable properties, which we have explained and illustrated elsewhere[n]. This standard being fixed and unalterable, the mean tropical year of which it is

[n] Fasti Catholici, i. 71. Diss. iii. ch. iii: ii. 27 sqq. Diss. ix. ch. i. sect. viii: iv. 143 sqq. Note. Diss. xv. ch. xiii. sect. ix: also Appendix to vol. iv. ch. i.

supposed to be the measure is fixed and invariable also; beginning and ending perpetually after the interval of mean solar time defined as above. And the mean vernal equinox being supposed to be the point at which it both begins and ends *de facto*, after the interval in question, the cycle of returns to and of departures from this point perpetually, consequently the cycle of mean vernal ingresses one after another, and one after the same absolute interval of mean solar time as another, is the Solar Cycle of division B of the Tables: a cycle, such as we there exhibit, of 6004 mean tropical years, of 6004 returns to this point, one after another, at the same distance of mean solar time asunder, without any interruption from first to last.

Section II.—*On the technical reckoning of the Solar Cycle of the Tables.*

The primary ingress of this kind, the beginning of this whole series of ingresses, is dated at the point of midnight, on April the 25th the feria prima, A. M. 1 B. C. 4004; but only for the meridian of the ancient Jerusalem, (or any other which is the same with that,) which in these Tables is assumed throughout as the *Primary Meridian;* i. e. as that meridian of which the coincidence in question, and any similar coincidence, first and properly held good[o]. And this fundamental date is not an hypothetical one, but *matter of fact;* attested, illustrated, and placed out of question by the entire course and succession of time of every kind, from the first day to the present.

Every subsequent ingress depends on this primary one; and all are obtained one after another, first and properly for the same meridian every year, by the simple addition of 5 h. 48 m. 50 sec. 24 th. to the primary ingress, and to each subsequent one in succession; and all are exhibited in our Tables, as so dependent and so obtained, for every year in its turn: the hours being reckoned from midnight, and the Julian dates on which each of these ingresses falls, from the first, April 25 at midnight, A. M. 1 B. C. 4004, to the 6004th, March 7=9 at 5 h. 15 m. 21 sec. 36 th.=5 h. 26m. 31 sec. 12 th. from midnight, A. M. 6004 A. D. 2000, being noted in order

[o] See the Fasti Catholici,' vol. ii. 58. Diss. ix. ch. iii.

also. Taken collectively, they constitute the perpetual Solar Cycle of our Fasti; the most important of all their divisions, or equalled in importance only by division E, devoted to the Primitive Calendar, of which we shall give an account by and by.

SECTION III.—*Recession of the Equinoxes of the Fasti in the Julian year.*

The mean annual standard of our Tables, (mean natural annual time, mean annual tropical time,) exceeding the actual Julian year of 365 days and nights of mean solar time by 5 h. 48 m. 50 sec. 24 th. of mean solar time; it will appear to gain on the actual annual Julian reckoning of the Tables at the rate of 5 h. 48 m. 50 sec. 24 th. every three years in succession: but every fourth year in order, (which is leap-year in the Julian reckoning of annual time, and in which consequently the actual Julian year contains 366 days and nights of mean solar time,) the mean annual tropical time of our Tables will be thrown back 44 min. 38 sec. 24 th. of mean solar time on the actual Julian: so that on the whole, and if the actual Julian year may be supposed to consist of 365 days and nights and 6 hours of mean solar time perpetually, mean annual tropical time of the standard of our Fasti may be assumed to fall back on actual annual Julian time, in the sense of mean, at the rate of 11 min. 9 sec. 36 th. or 11 m. 9·6 sec. every year. And this, it will be seen, with two exceptions only, is the standing difference between the mean annual tropical time exhibited in the Tables, and the mean annual Julian which must be supposed to accompany it, and to be equated to it, perpetually.

It is however to be observed, as we have already intimated, that on two occasions, (but only on two,) once A. M. 2485 B. C. 1520, and again A. M. 3295 B. C. 710, this standing difference of the mean annual tropical time of the Fasti and the mean annual Julian was augmented *per saltum* from 11m. 9s. 36th. to 12h. 11m. 9s. 36th. The causes of this anomaly have been largely explained in our general work: and the matter of fact itself, we trust, has been placed beyond doubt or controversy[p]. But with respect to the effect of

[p] Diss. v. vol. i. 237–383: and vol. iv. Appendix, ch. ii.

the anomaly on the various measures of time in general, and on this of the Solar Cycle of the Fasti in particular, and on the relation of the mean tropical to the mean Julian year, or *vice versa*, we necessarily refer our readers to the explanations which have been given elsewhere[q].

No cycle of *feriæ* is incorporated with this division: that is, the hebdomadal character of each of these ingresses, (the day of the week, on which each of our natural vernal equinoxes falls in successive years,) is not directly shewn therein. The cycle of feriæ, attached to the mean Julian equinoxes in the next division (C), is competent to serve for this also; and through the hebdomadal character of the Julian date on which it falls, will indicate that of each of these natural ingresses perpetually.

iii. *Third division of the Fasti, or division* C. *Julian Types and Julian Periods of the Fasti. Cycle of Julian and Gregorian equinoxes.*

SECTION I.

The third division is denoted by the letter C. It comprehends the Julian Periods and Julian Types of the Fasti; or the cycle of mean Julian or Gregorian equinoxes, as adapted constantly to the solar cycle of division B: i. e. as the Julian or Gregorian representatives of each of the natural vernal ingresses, the succession of which is exhibited in that cycle.

SECTION II.—*Julian Types of the Fasti, and their relation to the natural year.*

The Julian Types of the Fasti are the conventional or positive substitutes for the mean tropical year of the same, of which we make use in its stead. They are the nearest and closest approximation to the actual reckoning of mean natural annual time in terms of civil, which in the nature of things is possible[r]. It is assumed in these Tables, that some *conventional* and *positive*, that is, some *civil*, mode of reckoning even mean natural annual time must be employed perpetually: and, if so, that none could be used with so much propriety, none could be so properly substituted for natural

[q] Diss. v. vol. i. 237–383: and vol. iv. Appendix, ch. i. sect. ii. Diss. iii. ch. iv. sect. iv: 124. sect. vii: 125. sect. viii.
[r] See the Fasti Catholici, vol. i. 119.

annual time, as civil in the sense of Julian: the object proposed by these Tables being to connect the actual reckoning of annual time (indeed that of time of every kind), from the first, with the very same thing which exists at present, and *as* it exists at present. And mean natural time, as reckoned at present, is mean annual time either in the form of Julian, or in that of Gregorian which differs *per accidens* only from Julian. Every condition therefore of the reckoning of annual Julian time is considered essential to our Tables, and indispensable to them from the very first; and every such condition may be seen to be observed in them from first to last. And among these none is more important than the cycle of leap-year, and the cycle of 28 years, or cycle of the Dominical Letter.

SECTION III.—*Julian Periods of the Fasti.*

The stated annual difference of the mean tropical year of the Fasti and of the mean Julian year being 11 m. 9 s. 36 th., it may be assumed that it accumulates to a day and a night exactly in 129 mean natural or mean tropical years*. But 129 is not a multiple either of 4, the Julian cycle of leap-year, or of 28, the cycle of the Dominical Letter.

If we multiply 129 by 4, we obtain a period of 516 years, which is divisible by 4 and consequently is a multiple of the cycle of leap-year. But it is not divisible by 28, and therefore it is not a multiple of the cycle of the Dominical Letter. In 516 mean tropical years of our standard too, or 516 mean Julian years, the difference between the tropical year of the

* In strictness it accumulates only to 23 h. 59 m. 38 s. 24 th.: i. e. 21 s. 36 th. *less* than one period of 24 hours of mean solar time.

Supplementary Tables of the Fasti.

TABLE XXXIV.

Precession of the mean Julian year on the mean tropical.

yrs.		h.	m.	s.	th.
100	=	18	36	0	0
20	=	3	43	12	
9	=	1	40	26	24
129	=	23	59	38	24
				21	36
		24	0	0	0

Fasti and the Julian would be found to be nearly four days and nights complete*: an amount of disparity much too considerable to be allowed to be generated at one time, or to continue uncorrected until it was so generated at once.

The necessity of the case then suggests the only alternative and the only expedient left; viz. that of assuming a Julian Type of the natural or tropical year, which shall always be a multiple of the cycle of 4 and of the cycle of 28, and shall always stand in a definite relation to the period of 129 years, even though it should be of variable length in itself, and greater at one time than at another. And we find this TYPE in the MEAN JULIAN PERIOD of 112 years at one time, and of 140 at another; each of them a multiple of 4 and also of 28, and therefore a perfect measure both of the cycle of leap-year and of the cycle of the Dominical Letter perpetually; and the latter almost as much greater than the period of 129 years as the former is less †. The latter there-

* *Supplementary Tables.*

TABLE XXXIV.

Precession of the mean Julian year on the mean tropical.

yrs.		d.	h.	m.	s.	th.
500	=	3	21	0	0	0
10	=		1	51	36	0
6	=		1	6	57	36
516	=	3	23	58	33	36
			+	1	26	24
		4	0	0	0	0

† Precession, 112 years.

yrs.			h.	m.	s.	th.
100	=		18	36	0	0
10	=		1	51	36	0
2	=			22	19	12
112	=		20	49	55	12
		+	3	10	4	48
		1d	0	0	0	0

Precession, 140 years.

yrs.			h.	m.	s.	th.
100	=		18	36	0	0
40	=		7	26	24	
140	=	1d	2	2	24	0
		−	2	2	24	
		1d	0	0	0	

	h.	m.	s.	th.
Defect in 112 tropical years on the period of 129 ..	3	10	4	48
Excess in 140		2	2	24
Difference	1	7	40	48

In the actual administration of our Julian Periods, this excess of 1 h. 7 m. 40 s. 48 th. in the period of 140 years, above the defect in that of 112 years, is made up for by the alternation of the Periods; which is such that there are more of 140 years than of 112: as will appear on examination.

fore is well adapted to compensate for the former; and (both being referred perpetually to one and the same standard of 129 years, as the proper measure of the relation of the mean tropical to the mean Julian year) it makes up for defect upon that standard at one time by excess over it at another.

The Julian Periods of the Fasti then are sometimes 112 years in length, sometimes 140; and, on each of two occasions (but only two), from the special reasons of the case, 56 years in length, which under the circumstances of the case however are virtually the same thing as 112. These periods are the measures of the duration of our Julian Types. They are the length of time for which each of these Types is used for its proper purpose, before it is superseded by another. And each of these Types, so limited in point of duration, is a perfect exemplar, for the time being, of the Julian reckoning of annual time according to all its conditions. Each, as long as it lasts, is subject in all respects to the laws and rules of the Julian calendar. By means of these Types consequently, one after another, the same nominal Julian reckoning is carried on in a manner absolutely uniform, absolutely identical with itself, from first to last. And, what is more, each of these Types is as true and exact a representation of the actual reckoning of mean natural annual time, (which must be supposed to be going on at the same time all along,) as in the nature of things is possible; one of them after another, and one of them as much as another: and the first of the number not less so than the last, though the former is more than four thousand years older than the first beginning of the Julian reckoning of natural annual time at present, the latter is nearly two thousand years younger.

SECTION IV.—*On the principle of the relation of the Julian Types of the Fasti to the natural year, and of the substitution of the former for the latter.*

The fundamental principle of this relation of the Julian Types of our Fasti to the mean natural or tropical year, and of the substitution of the former for the latter perpetually, is *this:* That an artificial, i. e. a conventional and positive, measure of natural annual time is competent to serve in its stead, for the measurement, reckoning, or computation of

civil annual time, and to be treated as if it were absolutely the same with it in all respects, so long as the actual difference between the natural prototype and the conventional, positive, or civil antitype of the same thing does not yet amount to, or does not yet exceed, 24 hours of mean solar time; i. e. one integral cycle of the mean solar day and night: but no longer. The only further distinction which we consider ourselves at liberty to make, in the application of this principle perpetually, is That the interval of time, during which the effect in question is to be supposed to be still going on, and to be still in the process of being completed, (i. e. in other words, the proper Julian Period of our Fasti,) if the necessity of the case so requires, may be *cyclically* reckoned; that is, not always in the same number of years, but sometimes at 112, sometimes at 140: provided it is never so reckoned in an arbitrary or capricious manner, but according to the order prescribed by the reason of things, and best adapted to compensate for defects at one time by excesses at another, and *vice versa*.

This alternation of Julian Types, so determined and so adjusted, once begun is never interrupted. It accompanies the actual annual reckoning of the mean tropical time of our Tables *pari passu*, from first to last. The actual Julian reckoning, in its proper order of time and proper place in the succession, serves the purpose of one of these Types as much as the regular one in the order of the succession of the Fasti at the same point of time; between which indeed, and the actual Julian, at that moment there was no difference. And having entered our Tables at this point of time, in the form of an entire and total coincidence with the Julian reckoning of the Fasti until then, the actual Julian reckoning continues in our Tables ever after; only in a shape thenceforward analogous to that of the actual Gregorian in comparison of the actual Julian at present. The same alternation and succession of types is as characteristic of the actual Gregorian administration of the calendar, in contradistinction to the actual Julian, as of that of our Fasti from the first; only that in the actual Gregorian, this alternation proceeds by three periods of 100 years each in succession, and a fourth of 200 years in length; in that of the

Fasti it proceeds all along in the same way, and according to the same rule, at one time in the period of 112 years, at another in that of 140.

SECTION V.—*Julian Epoch of the Tables.*

The first Julian Type of this description enters the Tables at the point of midnight April 25, A. M. 1 B. C. 4004, along with the first mean natural vernal ingress, for the meridian of Jerusalem. The annual Julian time of the Fasti then is reckoned from midnight; the annual natural or tropical is reckoned from midnight also: and this is a coincidence which should be constantly kept in mind. For annual time of each kind, having once begun to be reckoned in conjunction with the other from its proper beginning and according to its proper law, is never afterwards, not even for a moment, interrupted.

After this first Type *forty-seven* others also enter the Tables in succession; so as to make up *forty-eight* in all [r]; each at the point of midnight; each at the mean vernal equinox as cyclically reckoned from the point of midnight perpetually, (a supposition, never far from the truth at each of these times, whether actually the truth or not). The Julian dates of these ingresses, the Julian exponents of one and the same natural term which in itself is invariable, the point of the mean natural vernal equinox, descend in a regular series, (the common difference of which is unity,) from April 25, A. M. 1 B. C. 4004, the first, down to March 8=10, A. M. 5909 A. D. 1905, the 48th: a descent only once interrupted in terms, viz. A. M. 3333. B. C. 672, at the ingress of the xxviiith period: when (for reasons explained and cleared up elsewhere [s]) the Tabular date of the 3334th mean natural vernal equinox drops 24 hours of mean solar time more than usual; viz. from March 30 at midnight to March 28 at midnight; passing over March 29 *.

* These remarks apply to the arrangements of the printed Tables. What the real state of the case is, when the corrections which those Tables require are taken into account, will appear by referring to the Appendix to vol. iv. ch. i. ii.

r Cf. the Fasti Catholici, vol. i. 452. Diss. vi. ch. iv. and p. 501. ch. v.

s Fasti Catholici, vol. i. 316, Diss. v. ch. iii. sect. xv. and xvi.

SECTION VI.—*Proportion of the mean Julian time of the Fasti to the mean natural perpetually.*

The succession and alternation of these Types in division C being compared with the course of the Solar Cycle in division B continually; it will be seen that the difference between any one such positive type of the natural succession and this natural succession itself never exceeds 24 hours of mean time, nor is ever less than 18, before it is superseded by another; and that, in general, it approximates very nearly to the just amount of 24 hours, though it never surpasses that limit, before the type itself is changed. Now this is a degree of difference between the standard of nature, however absolute and invariable in itself, and the conventional representative of that standard for the time being, however incapable of agreeing with it perpetually, which is both reasonable in principle and allowable in practice. A greater degree of correspondency between the civil and the natural reckoning of the same thing perpetually, than this, is neither to be affected nor even to be desired. A perpetual civil type of the natural succession of annual time, in conjunction with noctidiurnal, which never departs from the first principles of the relation established between them, never varies from the fixed and unalterable standard of nature, beyond the extent of one day and one night complete, is as perfect of its kind, and as well adapted to answer every use and purpose which can be proposed in the reckoning of natural time in terms of civil at all, as the necessity of the case, or the reason of things, can possibly require. To aim at a greater degree of conformity between the standard of nature and the standard of convenience, than this, and at *all* times, rather than at *stated* times thus estimated and defined; is to attempt an ideal or theoretical perfection, which, for any practical use and benefit to which it could be subservient even if realized, would be idle and superfluous: though it must be admitted that such an abstract and ideal perfection has been not only attempted, but as far as was possible carried out in practice, and reduced to rule experimentally, in an actual correction of the civil calendar still in existence, of which we shall give an account by and by.

In comparing however the Julian Types of the Fasti with the Solar Cycle also, care should be taken to institute the comparison in the proper year of the Julian cycle of leap-year. The first year of natural annual time (i. e. the first year of the true Æra Mundana) was the second year of the Julian cycle of leap-year. The first Julian Type enters our Tables in the second year of this cycle; and so does every subsequent Type. *This* is consequently the year in which the comparison in question should be instituted. If there is such a thing as the cycle of leap-year even in the natural reckoning of annual time, (and that there *is* a cycle of the *leap-day* even in the natural reckoning of noctidiurnal in annual time, as much as in the Julian, we have shewn at large elsewhere[t]), it is from the *second* year of the proper Julian cycle of the same kind to the *second* year again perpetually. The epact of the mean natural year, beginning A. M. 1 with the first mean natural vernal ingress, April 25 at midnight, has gone on, from that time to this, accumulating to a day and a night complete, or to the nearest amount to a day and a night complete of which it was capable, once in every four years; which four years have constituted the proper cycle of leap-year, (at least of the leap-day,) in the natural year. And it is superfluous to add that, until the epact has thus accumulated to a day and a night complete, it cannot yet enter into the account of the noctidiurnal cycle in the natural year, (no more than in the Julian,) as kept in integral cycles of that kind perpetually, and in those only. It must stand over for a time in the reckoning of noctidiurnal as mixed up with annual time, until it amounts to a day and a night complete.

Would we know then the true relation of the Julian Type of the Fasti to the natural or tropical year, at any time in the decursus of its proper period; we must inquire into the state of this relation in the second year of the Julian cycle of leap-year. And it will always appear, from that inspection, that no Type of this kind is ever continued in use, after the recession of the first term in the natural year on the fixed Julian term which began to represent this natural one at the ingress of the period, and which continues to represent it at

[t] Fasti Catholici, vol. i. 468. Diss. vi. ch. iv. sect. iv.

the beginning of every fresh year to the end of the period, and on the point of midnight also to which that Julian term is constantly attached, has amounted to 24 hours: nor ever ceases to be used until it has approximated very closely to that amount, whether it has actually attained to it or not.

SECTION VII.—*On the Gregorian Types of the Fasti.*

Along with the Julian exponents of the mean natural vernal ingresses at the beginning of each of our periods, and for the decursus of the period, and in this same division C also, we exhibit the Gregorian likewise.

Whosoever has reflected on the relation of the Gregorian to the Julian reckoning of annual or of noctidiurnal time at present must be aware that the former differs from the latter only in appearance and name; not in reality. The same thing holds good of the Gregorian reckoning of the Fasti compared with the Julian perpetually. Both are intended to be the same thing; and *mutatis mutandis* each is the same thing as the other. The only difference is that as the natural year serves as the standard of reference for the Julian of the Fasti; so does the Julian of the Fasti for the Gregorian: for the simple enunciation of the state of the case in each of these relations is that, as the Julian Types of the Fasti are conventional or positive modifications of the natural type of annual time; so the Gregorian Type of the Fasti is a conventional or positive modification of the Julian.

The actual reckoning of natural annual time made use of at present being the Gregorian, it was by all means desirable that this too should be brought down from the first, as much as the Julian, in a succession of types of its own; each of them consequently, at a given time, to be derived from the Julian: just as the actual Gregorian reckoning in its proper order of time was derived from the actual Julian of the time being also, and virtually has been so derived ever since at all intermediate points of time, down to the present day[u]. The difference between the Julian and the Gregorian reckoning of annual time from the first and at present, as every one knows, is this: That both being supposed to bear date from the point of the actual vernal equinox in the

[u] Fasti Catholici, vol. i. 125. Diss. iii. ch. iv. sect. viii.

natural or tropical year, and, according to the proper Julian rule in the reckoning of the noctidiurnal cycle, from the point of midnight; annual Julian time is reckoned from a constantly varying term of this description, annual Gregorian from a fixed one: the former A. D. 1582 March 11, and at present March 9, the latter both A. D. 1582 and still March 21. But as to the reckoning of noctidiurnal time as well as annual in each of these styles; there is no difference between them. The variable Julian term, which is the first day of the natural annual succession for the time being in that form, and the fixed Gregorian one which represents it in the other, in the order of the hebdomadal cycle common to both are always the same: and while that is the case there can be no real difference between them, in any other respect, though there may be an apparent and nominal one.

This distinction holds good of the Julian and of the Gregorian equinoxes of our Fasti; viz. that both being referred to a third term, independent of each, i. e. the hebdomadal cycle, and to the order of *feriæ* in that, they are the same perpetually: the criterion of the identity between them being the place of each in the order of this cycle, or, as chronologers express it, in the order of *feriæ*. The nominal date of the Julian equinox, and that of the Gregorian, at a given time may be the same, or different; but the *feria* of the former is always identical with that of the latter, and *vice versa*: and so long as that is the case, every other difference between them must be accidental and apparent. For this reason, we have annexed one cycle of the Dominical Letter to the column of Julian equinoxes, in division C, adapted to the Julian reckoning of noctidiurnal time in terms of hebdomadal, according to our Fasti, perpetually; and another to the column of Gregorian, adapted to the Gregorian reckoning of the same thing: the former of which will always shew the Julian equinox for the time being, and the latter the Gregorian, on the same *feria* of the hebdomadal cycle. But to this subject we hope to return by and by.

The first Gregorian term which enters our Tables is the first Julian also, viz. April 25: and as the proper Gregorian exponent of the Julian vernal ingresses of our Fasti this continues unchanged from A. M. 1 B. C. 4004, the date of

the ingress of the first Julian Type, down to A. M. 3333 B. C. 672, that of the ingress of the twenty-eighth; and then it reappears in the modified form of April 24: April 24, in a course and succession of this kind reckoned from the first, for reasons which have been explained elsewhere[x], being absolutely the same thing after B. C. 672, as April 25 before. And all this time this one Gregorian term, April 25 from B. C. 4004 down to B. C. 672, and April 24 afterwards, answers alike to every form and expression of a nominally varying Julian term, (the Julian date of the mean vernal ingress for the time being,) and through that to the same fixed and invariable natural term, of which the Julian itself is only the variable exponent; the first integral cycle of night and day in the mean natural or tropical year: the test and token of the identity of each with the other all along, in the midst of constant apparent diversity, being the place of each in the feriæ of the hebdomadal cycle.

At the ingress of the xxxvth Julian Type, A. D. 225, this variable Julian term, in obedience to the law of the succession from the first, is found to be beginning to be March 21: and March 21 being the proper Gregorian representative of the natural vernal equinox, or the first day of the natural tropical year, in the actual Gregorian reckoning of annual time itself; no epoch could appear to be fitter than this, for discarding the second Gregorian term of the Tables, and substituting that of March 21 in its stead. In itself it is purely a matter of indifference, (i. e. of convenience, of positive appointment and arrangement,) what fixed term shall be designated to represent the Julian equinox in the Gregorian reckoning of annual time, and to receive the name of the Gregorian equinox; provided it is also the same as the Julian in relation both to the natural year and also to the hebdomadal cycle. Yet this substitution of the Gregorian term of March 21 for the Gregorian term of April 24, at the ingress of period xxxv, amounts virtually to the restitution of the proper Gregorian epoch from the first, April 25: for the number of days between March 21 and April 25 being 35 exactly, i. e. five weeks or five hebdomadal cycles; the feria of March 21 is necessarily the same as that of April 25.

[x] Fasti Catholici, i. 490. Diss. vi. ch. iv. sect. ix. iv. App. ch. ii.

To this subject however also we shall have occasion to recur again before we conclude.

The Gregorian epoch of the Tables then from A. D. 225 downwards is March 21: and this is the fixed and invariable term of that denomination, which from that time forward is to be constantly compared with, and constantly equated to, the varying Julian term for the natural vernal equinox: the link of connection between them being still as before the hebdomadal cycle. The administration of our Fasti indeed continues to proceed according to the same law after A. D. 225, as before; but from this time forward it becomes both actually the Julian and virtually the Gregorian of the present day at once: and as it passes into the actual Julian in this very year, A. D. 225, so does it into the actual Gregorian also, at the proper point of time, A. D. 1582. But on these, and on other important points connected with these, we shall have occasion to speak more distinctly in a different part of our Introduction.

iv.—*Fourth division of the Fasti, or division* D. *Lunar Cycle of the Tables.*

SECTION I.

The fourth division of the Tables is assigned to the letter D. It contains the Lunar Cycle of the Fasti. The Lunar Cycle is the lunar reckoning of the Fasti, in the constant succession of new moons, i. e. of mean lunar months from conjunction to conjunction perpetually; only according to a positive rule, that is a cyclical one, or the law of the administration of a regular lunar and solar cycle.

SECTION II.—*Primary Lunar Epoch, or Lunar Conjunction, of the Tables.*

The primary epoch or date of this continuous lunar reckoning is that of the first mean new moon or first mean conjunction for the meridian of Jerusalem; April 29 at midnight, A. M. 1 B. C. 4004: the proper relation of which to the primary new moon, or first actual conjunction for the same meridian, we have investigated, and to the best of our ability determined, in our general work[y].

[y] Fasti Catholici, vol. iv. Appendix ch. v.

The absolute beginning of lunar time indeed in constant connection with the present system of things is that which Holy Writ itself has defined; viz. the fourth day of the Hexaëmeron, April 28: not the fifth, April 29. But when the truth in relation to this point comes to be known, it turns out that this absolute lunar epoch was neither that of the first conjunction, nor yet that of the first opposition, (one of which has always been hitherto supposed;) but simply that of the last phasis of the moon, before the conjunction: i. e. that state and appearance of the old moon, and that point of time in the period of its revolution from conjunction to conjunction perpetually, in which and at which it may still be visible for the last time in the morning, rising not long before the sun. And this is another of those extraordinary discoveries which the true science of time, in all its measures from first to last, enables us to make; though hitherto not so much as suspected. And yet, in our opinion, it was always to have been divined from the testimony of Scripture itself, rightly understood: and if we are not mistaken it was known, by tradition, to the ancient Egyptians [z]. And what too can be supposed more reasonable and consistent in itself, or more to be expected *a priori*, than that the moon having been first made to appear, still more or less in the possession of its proper light, on the morning of the fourth day, i. e. before any human eye was yet in existence to see it; should first have become sensibly visible in the natural course of things, either on the evening of the sixth day of the Hexaëmeron (the evening of the creation of man), or at the latest on that of the seventh? which would be the necessary consequence of the fact of the primary conjunction at noon on the fourth day, or some time in the course of that day; the mean cyclical conjunction determined by which is the primary one of the Tables, April 29 at midnight.

SECTION III.—*Type i and ii of the Lunar Cycle of division D. Type i, or the Ennea-kai-dekaëteris.*

Now from this primary epoch the lunar reckoning of the Tables is brought down without interruption to the present day, in two parallel successions, Type i and Type ii of the

[z] See our Fasti, vol. iv. 368 sqq. Diss. xviii. ch. ii.

same Lunar Cycle in general; each of which enters perpetually into this fourth division: Type i, in the shape of the Ennea-kai-dekaëteris, or Metonic cycle of 19 years, and Type ii in that of the Hek-kai-dekaëteris, or lunar cycle of 16 years.

The peculiar period of each of these Types is the same; viz. the Hipparchean, of 304 mean or actual Julian years: in which there are 16 cycles of 19 years, and 19 cycles of 16 years. In the course of one of these periods, the true reckoning of mean lunar time loses one day exactly on the calendar or cyclical, or may be assumed to do so; and therefore at the end of every such period, in order that these calendar or cyclical dates may be again adjusted to the true, and prepared for the decursus of another period in the same manner as before, they require to be all lowered one day. The primary lunar epoch of the Tables consequently drops one day in terms every 304 mean Julian years. And as 20 of these periods enter our Tables in all, it drops 19 days in all; the first lunar epoch being April 29 at midnight, A. M. 1 B. C. 4004, the last April 10 at midnight, A. M. 5777 A. D. 1773.

The number of lunar months, cyclically reckoned from conjunction to conjunction, contained in one of these periods, and the number of mean or true similarly reckoned, are the same: 3760 in either case alike. The number of both kinds, comprehended in all our periods collectively, is consequently 3760 × 20, or 75200: the entire number of natural lunar months, reckoned from syzygy to syzygy, between April 29 A. M. 1 B. C. 4004 and April 9 A. M. 6081 A. D. 2077, which would be the proper date of our xxist lunar period of 304 years, had we continued the series *in annis expansis* so far. Of each of these in its turn the date is shewn by our Tables, not only in the cyclical style of the Tables themselves as conformed perpetually to a technical or positive rule of reckoning, but even in the natural succession of true lunar time itself, and with a degree of exactness which never varies, beyond certain limits, from the truth.

SECTION IV.—*Type ii, or the Hek-kai-dekaëteris.*

The Hek-kai-dekaëteris is that form of the lunar reckoning, according to a cyclical or calendar rule, which approaches

most nearly at all times to the true reckoning of mean lunar time. Its closeness to nature in this respect is such that, if it has any inherent defectiveness, it derives it from this property of its relation to the mean lunar reckoning itself: its tendency even in the style of the calendar being to fall back on the true lunar reckoning, rather than to gain upon it. For this reason it requires a special correction of a day and a night, properly speaking every 160 years; though for the sake of convenience we administer one at the end of the ninth cycle of 16 years in every period of 304 years, and another at the end of the period.

The Ennea-kai-dekaëteris on the other hand is the better adapted of the two to be the perpetual representative of the true lunar reckoning, except in the last four cycles of every period: and even for these, though no longer true to the new moons, it will still be true to the phasis. And indeed, under almost any circumstances within the compass of one and the same period of 304 years, it will still be faithful either to the new moons or to the phasis. In this type too the same Julian dates continue attached to the same lunar ones, in the same years of the cycle, perpetually: in the Hek-kai-dekaëteris they rise three days in the course of every cycle. And though this peculiarity of the lunar reckoning of the Hek-kai-dekaëteris in terms of the Julian calendar does not detract from its usefulness as a constant measure of true mean lunar time; it interferes materially with its applicability in practice, for any purpose which requires the reckoning of lunar time even in the calendar to be restricted to the same seasons of the year, as well as to the same days of the month.

We shall have occasion to recur to this subject of the Lunar Cycle of the Fasti again. We shall therefore observe further merely that the lunar time of each of our Types is reckoned from midnight in mean solar time perpetually, for the proper meridian. The primary, principal, or cardinal new moon of every period, and of every cycle of the period, is of course the first of all: and the first to answer to that description is assumed to have been that of April 29 at midnight, for the meridian of Jerusalem. On this all the rest depend; and from this they have all been obtained according

to the cyclical rule of the reckoning, in a manner which will be more particularly explained by and by.

Lastly, there is no cycle of feriæ, or cycle of the Dominical Letter, incorporated with this division. The cycle included in division C serves for this division also, if necessary. It is the proper solar cycle of our Julian dates of every kind: and all our lunar dates, in both our Types, are Julian.

V.—*Fifth division of the Fasti, or division* E. *Æra Cyclica of the Tables, and the Primitive Calendar.*

SECTION I.—*Importance of this division.*

The fifth division is distinguished by the letter E. It comprehends the ÆRA CYCLICA of the Tables and the PRIMITIVE CIVIL CALENDAR.

No part of these Fasti Catholici (with the exception of divisions B and C) is of an importance like that of this, with respect to the use which it is possible to make of it, the discoveries to which it is found to lead, and the light which it throws on a multitude of most curious, most interesting, most important, but hitherto most obscure and uncertain points; on which the sagacity of learned men has been exercised ever since the revival of letters, without penetrating into the truth, and which are still as much the subjects of controversy and difference of opinion, as ever: because, without the assistance of this particular division, none of these questions could have been finally decided. No part indeed of the whole system of time is superfluous. None can be dispensed with: none can stand by itself, independently of the rest. The concatenation of time is made up of individual but indissoluble links; each of them as essential to the integrity and continuity of the entire chain, as the rest. But to the antiquarian, to the historian, to the chronologer, to the philosopher, and even to the believer in the truth of Scripture, and to the champion and propugnator of Revelation against the popular scepticism of the day, the most useful, the most indispensable, the most valuable in every point of view, is the fifth division of our Tables, of which we are about to give a brief account; though for the full and complete explanation of it in all its details, we must of necessity refer to our general work—and

more particularly to the part entitled Fasti Cyclici and Origines Kalendariæ[a].

In this division all the varieties of the civil calendar, which mankind at different times have either actually used, or under the circumstances of the case possibly could have used, are summed up and comprehended in their simple elementary form. The sources and springs of all calendars, whether solar or lunar, which ever had an actual existence, or still have an actual existence, ANY WHERE in the WHOLE WORLD, (the ORIGINES KALENDARIÆ properly so called, in the most comprehensive sense of the terms,) lie concealed in this division, and always have done. *Here* they are to be sought for, and *here* they are to be found, if *any where:* that is, if they ever had an actual existence. On this point we speak from personal experience. It has pleased Almighty God, by means of the clue thus put into the hands of one inquirer, and by his own blessing on his individual investigations, to bring to light many more than one hundred of the calendars of past time, which might have been supposed irrecoverably lost, and incapable of being restored. What may not be expected, when the same clue is put into the hands of many equally competent persons? when many more, trusting to the same blessing on the same labours and inquiries, shall be engaged at once on the same pursuit?

SECTION II.—*On the Primitive Calendar, and Primitive Civil Year.*

Now the primitive calendar, i. e. the primitive civil year, in question was nothing more than a continuous reckoning of solar time, by the period of 24 hours, or noctidiurnal cycle: i. e. by cycles of 365 such periods, or 365 days and nights of mean or apparent solar time, perpetually. Chronologers call this form of the civil reckoning of annual time sometimes the *equable,* sometimes the *vague,* the *erratic,* or *wandering* year; but its true name and description, in the sense which has just been explained of the same complex or cycle of integral days and nights perpetually, is that of the EQUABLE SOLAR YEAR.

In itself consequently it was a fixed and invariable measure

[a] Vol. i. 542 sqq. Diss. vii: 610 sqq. Diss. viii.

of time; only in terms of the cycle of day and night: as fixed and invariable at least as the cycle of day and night itself, which every one knows to be the most fixed and unchangeable thing in nature. And in these Fasti of ours, which exhibit the exemplar, fac-simile, or representation of this primitive reckoning of annual time perpetually, this constant and equable succession in terms of the cycle of day and night never has varied. Nor has any year of this description ever entered division E of the Tables, under any denomination, which has consisted *de facto* of more or of less than 365 cycles of actual day and actual night.

As referred to the natural standard of annual time (mean tropical annual time) this equable primitive year, it is evident, was always the nearest approximation to the actual length of the mean natural or tropical year, in integral cycles of day and night perpetually, which in the nature of things was possible: for there never was any such natural year, nor is there any still, considered as an unit or integer of the same kind perpetually, which did contain or does now contain either more or less than 365 entire cycles of day and night.

In this primitive calendar each of the months was the same in length; and there were twelve in all, each of them 30 days long: and there were five days over and above, at the end of the twelfth month, which entered into none of the months of the calendar, but constituted a small cycle or period of their own, which it would not be proper to call a month, except as a month *sui generis*, and very imperfect and incomplete in comparison of the rest. Chronologers have given these five days the name of the *epagomenæ* of the equable year; from a Greek word, the literal meaning of which is *superinduced:* as if they had been taken in, carried on, or supplied, at the end of the last month, over and above the rest, to make up the calendar reckoning of the days of the year. The meaning of this name therefore, so applied, is much the same as that of Epact, which is derived from the same root in the Greek, and in its proper chronological sense has long been naturalized in our language. These epagomenæ however are not peculiar to the equable year. The Julian year too would have its epagomenæ; i. e. five days at

the end of the year in the common years of the cycle of leap-year, and six in the leap-year itself, did the length of the months in the Julian year follow the same rule as that of the months in the equable. As it is, the epagomenæ of the Julian year are absorbed in such of its months as have 31 days instead of 30.

The rule of all antiquity, with respect to these epagomenæ or supplementary days at the end of the calendar, appears to have been never indeed to leave them out of the account of the year (for that was impossible) but very commonly out of the reckoning of the months: so that in general allusions to the length of the year, though it was well known to consist in reality of 365 days and nights, it is frequently spoken of as if it consisted of no more than 360. For the same reason, even when the rest of the months received proper names, these five days were generally left without any appellation of their own. They seem to have been considered almost everywhere as *dies non*, and to have been treated almost everywhere accordingly; and almost everywhere to have been applied to some use and purpose to which no five days in the year were applied besides, (at least at first): and commonly too, though not always nor everywhere, as days on which nothing was to be thought of, nothing was to be transacted, which was σπουδῆς ἄξιον—nothing was to be minded, nothing was to be permitted, but festivity, pastime, amusement of some kind or other. And of this latter mode of applying them the history of the past furnishes a memorable and lasting example, to which we have already adverted, in the Olympic games of Pelops. For the feriæ devoted to these games in the first instance were nothing more or less than the epagomenæ of the primitive year.

But with respect to the succession and discrimination of the months themselves in this primitive calendar; it appears to have been the general rule originally to give them no names but those of order and number, as first, second, third, and so on. This is the Scriptural rule, down to the date of the Exodus at least, as every reader of Scripture must have observed. It is still the rule in China, and in other quarters of the world, at this very day. Proper names of the months appear in the Bible first in connection with the change or

correction of the calendar for the time being, which it pleased the Deity to prescribe, only 14 days before the Exodus, for the particular use and observance of the children of Israel. Proper names appear too, in connection with the primitive calendar itself, at a very early period in Egypt; and as these are the most ancient and most authentic which we have any where met with, out of Scripture, and yet the calendar to which they belong was always the same as the primitive, (i. e. always the same equable primitive measure of annual time from first to last,) we have concluded that we could not do better than borrow these Egyptian names, for the use of the primitive calendar of our Fasti. And therefore we shall subjoin them here, along with the Scheme or Type of this calendar; but in their Greek form, through which we know them most correctly at present [b].

Names, order, and length of the months of the Primitive Calendar of the Fasti, under their Græco-Egyptian styles and titles.

Order or Number of the Month.	Names.		Length in Days.
i	Θωὺθ, or Θώθ	Thoth	30
ii	Φαωφί	Phaophi	30
iii	Ἀθύρ	Athyr	30
iv	Χοιάκ	Chœac	30
v	Τυβί	Tybi	30
vi	Μεχείρ	Mecheir	30
vii	Φαμενώθ	Phamenoth	30
viii	Φαρμουθί	Pharmuthi	30
ix	Παχών	Pachon	30
x	Παϋνί	Paüni	30
xi	Ἐπιφί	Epiphi	30
xii	Μεσορέ, or Μεσορί	Mesore, or Mesori	30
			360
xiii	Appendices: Ἐπαγόμεναι (ἡμέραι): in after-time Mensis parvus, and El-Nesi		5
			365

Section III.—*On the Types of the Primitive Year, exhibited in the Tables, Type i and Type ii.*

Two Types of this Primitive Calendar or Primitive Year are incorporated in division E of our Fasti, and are brought

[b] See our Fasti Catholici, vol. iv. 183–195. Diss. xvii. ch. i. sect. iv–vi.: cf. p. 498. Diss. xix. ch. i. sect. xi.

down in juxtaposition one with the other, from first to last; i. e. Type i and Type ii. Type i is that form of this equable year which we have found it necessary to distinguish by the name of the CYCLICAL: Type ii is that which, in order to discriminate it from the other, we have been obliged to denominate the NABONASSARIAN. The difference between them may be summarily yet intelligibly explained as follows.

Each of these Types contains all along the same number of days and nights; viz. the proper number which ought to enter into the equable year perpetually: and each, at a given time, is either absolutely or relatively the same as the other. But the relation existing between them at all times is that of the two types of annual time, of which we make use also, one to the other; viz. that of the natural type of annual time, and that of the Julian type of the natural recognised and adopted in our Fasti: of each of which we have already given an account. The Cyclical Type of the equable year stands exactly in the same relation to the Nabonassarian, as the natural type of annual time to the Julian one of the natural in our Fasti. The true never-varying standard of mean natural annual time is the mean natural or tropical year of the Fasti; and the true never-varying Type of equable annual time is the Cyclical Type of the Fasti. The Nabonassarian is a variable form of the Cyclical; just as the Julian type of the Fasti is a variable form of the natural. And there is this further connection between these two things respectively; that, as often as we change the Julian type of the natural year, so often do we also change the Nabonassarian Type of the Cyclical: but the Cyclical Type of the equable year, like the natural type of the tropical year, never undergoes any change in our Fasti. The same Nabonassarian Type consequently serves its proper use and purpose for just the same length of time as the same Julian; that is for one of the Julian periods of the Fasti, but no longer. And yet, as the same Julian notation of natural annual time runs on, without interruption, through all these Julian types; so does the same continued notation of equable annual time through all these changes of the Nabonassarian. These two things in short, *mutatis mutandis*, are absolutely the same; viz. a never-varying annual type, which we derive perpetually from the

mean natural or tropical year, and a never-varying cyclical type, constantly supplied by the cycle of day and night in the natural cycle of the year: a Julian type, perpetually accommodating itself to the former, and a Nabonassarian constantly assimilating itself to the latter: a Julian type, nominally and in comparison with itself, always varying, yet, as referred to its proper exemplar or antitype, always remaining the same; and a Nabonassarian type always appearing to be changing, yet preserving in reality all along one and the same relation to the Cyclical[c].

SECTION IV.—*On the Julian Style of both the Types of the equable year of the Tables.*

It is the object and also the effect of this fifth division, to exhibit the Julian date both of the Cyclical Thoth, (i. e. of the first day of Type i of this equable year,) and also of the Nabonassarian Thoth, (i. e. of the first day of Type ii of the same); and of both in terms of the Æra Cyclica, and in terms of the Æra Mundana, and in terms of the Æra Vulgaris, from first to last. To do this without any error required much caution and circumspection; yet, if we mistake not, (and we thank God for it,) it has been successfully accomplished: and not a single oversight or inaccuracy has crept into this part of our Tables from beginning to end.

These dates however are reckoned in our Tables perpetually not according to the Julian rule of the noctidiurnal cycle, from midnight to midnight, but according to the primitive, from sunset to sunset[d]; or, as it may be assumed without any material error, from 18 hours of mean solar time after midnight to 18 hours again perpetually. And this distinction should be kept in mind: though it is easy to reduce this mode of reckoning at any time to the Julian. These dates too are marked in terms once in every Julian cycle of leap-year, and that in the leap-year of the cycle itself; in which the equable style drops or descends a day on the Julian: and sometimes not only in the leap-year, but in

[c] Cf. the Fasti Catholici, vol. i. 127. Diss. iii. ch. iv. sect. ix. and p. 129. sect. x.

[d] See the proof of the fact of this rule, as made out on the principle of an almost universal induction, Fasti Catholici, i. 131 sqq. Diss. iv.

the first year after leap-year too; i. e. as often as the equable dates, under their proper Julian exponents, happen to be falling between December 31 and February 29: the first of these dates, in such cases, serving for the last year of the cycle of leap-year, the second, from the first to the third inclusive. We note down these equable dates in terms of their proper Julian exponents seven times in the course of every cycle of 28 Julian years: and as a general rule the same Julian date serves for the equable, for one cycle of the Julian leap-year.

In the second of these Types too, i. e. in the Nabonassarian form of equable annual time, it will be seen that these Julian dates drop one day in the Julian notation every four years, or every cycle of the Julian leap-year, and in the Julian leap-year itself; that being the year in which the number of days in the actual Julian year necessarily exceeds the number in the equable by unity: and that this law of the succession of such dates in Type ii is never once interrupted. On the contrary, the same succession in Type i (i. e. the Julian dates of the Cyclical Thoth,) does not descend uniformly one day every four years. It is sometimes stationary for eight years, or two cycles of the Julian leap-year, in sequence. But these, it will also be seen, are precisely the times when one Julian Type is leaving our Tables, and another is coming into them. The effect of this change of the Type in appearance is always as if the usual cycle of leap-year, under such circumstances, were dispensed with, and a Julian year were reckoned as common *extra ordinem;* i. e. as if it contained only 365 days and nights, when it ought to have contained 366: though in reality, even under such circumstances, the cycle of leap-year is not dispensed with; nor is any Julian year, from first to last, in our Tables actually reckoned as common which ought to have been reckoned as a leap-year.

SECTION V.—*Date of origination of both the equable Types.*

The primary Cyclical Thoth, (i. e. the Julian date of the first Cyclical Thoth,) the absolute epoch of Type i of the equable year, was nothing distinct from that of noctidiurnal and of annual time itself, except in its being reckoned, con-

formably to the primitive rule, from April 24 at 18 hours, instead of from April 25 at midnight, A. M. 1, B. C. 4004. And this is the epoch of origination of the true Æra Cyclica, that of these Tables, reckoned from the first day of the first Cyclical Thoth, to the first day of the same again, ever after; April 24, A. M. 1 B. C. 4004, at 18 hours of mean solar time from midnight, the feria prima *ineunte* according to the primitive, though not according to the Julian, rule.

The Nabonassarian Thoth being traced back to the beginning of things according to the proper law of its succession in the Julian year; the first day of the first Thoth of this kind too, the proper Julian date of the first day of the first Thoth of Type ii of the equable year, is found to be determined to May 20 at 18 hours, A. M. 1 B. C. 4004, the feria sexta *ineunte*, according to the primitive rule. But the true Nabonassarian term, (i. e. equable term in Type ii,) which answered at this time to the first day of the first Cyclical Thoth, or first equable term of Type i, (the absolute epoch of noctidiurnal and annual equable time,) was not Thoth 1 of the Nabonassarian year which must be supposed to have begun to be current on May 20 at 18 hours, but Mesore 10 of the Nabonassarian year which must be supposed to have expired at that time: Mesore 10 in this year of Type ii, and Thoth 1 in the first year of Type i, (the first year of the actual Æra Cyclica,) being absolutely the same with each other, because each of them at that moment was altogether the same with two other things, the Julian April 24 and the feria prima of the hebdomadal cycle, each reckoned from 18 hours after midnight.

Mesore 10 then must be considered the proper epoch of origination to Type ii of the equable year; but only as the same thing substantially, if not in name, with Thoth 1, the epoch of origination of Type i: and both as the same with the Julian April 24 at 18 hours, A. M. 1 B. C. 4004, and with the hebdomadal feria prima similarly reckoned. And were the equable reckoning of noctidiurnal and annual time still in use at present as it was at first, and still in the same state in which, in that case, it must have come down from the first; Mesore 10 of Type ii, in the proleptical year of the Æra of Nabonassar which answered to Æra Cyclica 1 at first, must

have been the epoch to which we should have been found referring the reckoning of the equable year at present; though still only to Mesore 10 at that time as absolutely and entirely the same, in every thing but the name, with Thoth 1 of Type i at that very time. Mesore 10 at least would still have been this epoch down to B. C. 672 Æra Cyc. 3335; and Mesore 9 after it: Mesore 9 in the equable reckoning according to Type ii, from first to last, after B.C. 672, (for reasons which have been explained in the proper place[e],) having stepped into the place of Mesore 10 in the same reckoning before it: just as the Julian April 24 dated from midnight, or April 23 at 18 hours from midnight, after B.C. 672 succeeded to the place of April 25 at midnight or of April 24 at 18 hours from midnight, before B.C. 672. On these points however, which are too complicated to be adequately discussed at present, and too important to be summarily dismissed or superficially treated of and discussed; the necessary explanations and information will be found to be supplied elsewhere[f].

SECTION VI.—*Æra Cyclica of the Tables, and Æra of Nabonassar.*

Along with the Cyclical Thoth, i. e. the first day of the Thoth of Type i, we exhibit the Æra Cyclica from the first; i. e. the true reckoning of the years of the world in terms of the primitive cycle of 365 days and nights perpetually: and along with the Nabonassarian Thoth, or first day of the Thoth of Type ii, we exhibit the Æra of Nabonassar, but only from the time when it began to have an actual existence; that is, from A. M. 3258 B. C. 747 downwards. Until then, the Æra of Type ii and that of Type i must be considered the same. Nor, in the nature of things, could one æra of this particular description, except *per accidens*, differ from another; because one year of 365 days is necessarily equal to another.

The actual epoch of the Æra of Nabonassar however, in the Æra Cyclica, was 3260; which year in the Cyclical reckoning of annual time corresponded to A. M. 3258 in

[e] Fasti Catholici, vol. i. 642. Diss. viii. ch. ii. sect. x.
[f] Fasti Catholici, i. 610–694. Diss. viii.

the Æra Mundana, and to B. C. 747 in the Æra Vulgaris. The difference between the two æras consequently from the first, in equable years, was 3259. And this difference between them continues to hold good ever after; the last year of the Æra Cyclica which enters our Tables being the 6008th, and the last of the Æra of Nabonassar being the 2749th: between which the difference is still 3259 as at first.

It will be observed that the Æra Cyclica of the Tables, and the Æra of Nabonassar, are directly connected with the Æra Mundana and the Æra Vulgaris though the Julian dates of their respective Thoths, perpetually. To find the year of the world, or the year before or after Christ, in which every year of either of these æras, exhibited in our Tables, as dated on the first of Thoth in its own style, and under the proper date corresponding to that in the Julian style, enters the Tables successively; the reader must carry his eye along the horizontal line which extends from the given year in division E to the corresponding year in division A on the left: and the year which is found there will be the year in question, both in terms of the Æra Mundana and in those of the Æra Vulgaris.

If there should still be any doubt upon this point, (as under particular circumstances there may be,) the column of Feriæ, attached to the Cyclical Thoth, and through that to the Julian date, in division E, compared with the cycle of the Dominical Letter in division C, (i. e. with the Julian cycle of that letter down to A. D. 225, and with the Gregorian after A. D. 225,) will always decide that question: and the similar column in the same division E, attached to the Nabonassarian Thoth and to its Julian date from A. D. 225 downwards, by being compared with the Julian cycle of the Dominical Letter in division C from A. D. 225 perpetually, will do the same thing for that. And this is a test or criterion of the equable annual reckoning in terms whether of the Æra Mundana or of the Æra Vulgaris, each of which is Julian (or may be considered so) perpetually, which will never be found to fail.

SECTION VII.—*On the proportion of the Thoth of Type i to the Thoth of Type ii perpetually.*

As the Cyclical Thoth Æra Cyclica 1 was falling on April 24 at 18 hours from midnight, and the Nabonassarian Thoth, in the corresponding year, was bearing date on May 20 at 18 hours from midnight; it is manifest that there was a difference in the reckoning of equable annual time from Thoth 1 to Thoth 1 perpetually, in one of these Types, compared with the same kind of reckoning in the other, from the first, which amounted to 26 equable days and nights: a difference of *plus* on the one side to that extent, and of *minus* on the other, respectively. We mark this distinction accordingly, at the ingress of the first Julian Type of our Tables, (which is also that of the first Nabonassarian one,) by $\pm$ 26: implying thereby that 26 days being added to the date of the Cyclical Thoth, i. e. to the first day of Type i, at this point of time, will give you the date of the Nabonassarian Thoth, or the first day of Type ii, at the same time: and *vice versa,* that 26 days subtracted from the latter will give you the date of the former.

We continue to mark this difference, in the same way, at the ingress of successive Julian or Nabonassarian Types and Julian Periods, after the first, Æra Cyc. 1 A. M. 1 B. C. 4004, down to the twenty-seventh, Æra Cyc. 3279 A. M. 3277 B. C. 728: and it will be perceived that it goes on decreasing by unity, with the ingress of every fresh Type; and therefore that at this particular time, (the date of the ingress of Type xxvii,) it is reduced to ± 0. The ingress of this Type consequently, and its proper date in each of these æras, Æra Cyc. 3279, Æra of Nabonassar 20, Æra Mundana 3277, and Æra Vulgaris 728, is the date of the first total and absolute coincidence of Type i and Type ii of the equable reckoning of noctidiurnal and annual time from the first: which began indeed in a state of coincidence, but only relatively, because under a different name in the proper style of each, and from a different equable term in each; but never had met together before, nor coincided in all respects, until now.

Of the importance of this coincidence, and at this particu-

lar point of time, we have said enough elsewhere[g]. Yet it lasted only 56 years; viz. from Æra Cyc. 3279 Æra Nab. 20 A. M. 3277 B. C. 728, to Æra Cyc. 3335 Æra Nab. 76 A. M. 3333 B. C. 672: and at the ingress of our twenty-eighth Julian Type, which then took place, and that of the twenty-eighth Nabonassarian also, the two Thoths began again to differ, and as before by a day. But the relations of the difference to each respectively from this time forward were inverted: for both Thoths having passed through ± 0 B. C. 728–B. C. 672, the difference between them B. C. 672 became ∓ 1: i. e. from this time forward the common difference was to be subtracted from the date of the Cyclical Thoth to get that of the Nabonassarian, or added to that of the Nabonassarian to obtain that of the Cyclical. And if we follow the two Thoths, in this new state of their relation to each other, to the end of the Tables, we find that as the difference between them began with being ± 26, so it ends with being ∓ 21; i. e. very nearly as much the contrary way: the last cyclical Thoth being April 30 at 18 hours, the last Nabonassarian one April 9 at 18 hours *.

It follows too, from this relation of the two Thoths to each other, in the same Julian notation of each perpetually, (one of them being so much higher, the other so much lower, in terms of a common reckoning); that the sum of the equable Æra in one of these Types and that in the other, at a given time, will not always appear to be the same: but occasionally will seem to differ from each other by one year. This happens as often as the first day of the Thoth of each, (the first day of Type i and Type ii respectively, in its proper æra,) in the course of the revolution, which both are constantly de-

* It is however to be observed here, that this increasing difference from A. D. 225, the ingress of Period xxxv, downwards, is merely nominal and apparent; analogous to that of the Julian and Gregorian reckoning, from a given point of time perpetually. The real difference between the two Thoths, at the ingress of Period xxxv A. D. 225 Æra Cyclica 4232 Nab. 973, was eight terms and no more. And it has never been any thing more or less than eight terms, from that day to this. See our Fasti, i. 644; Diss. viii. ch. ii. sect. xii, where this point is fully explained.

g Fasti Catholici, i. 639. Diss. viii. ch. ii. sect. ix: 657. ch. iii. sect. i. Art. x.

scribing round every term in the fixed natural or Julian year in order, is coming at stated times to a coincidence with January 1.

If the equable Thoth of either kind falls on January 1 in the Julian leap-year, it will also fall on December 31 the same year; and two equable years will begin in the same Julian year, one on the first day, the other on the last, thereof. Now this comes to pass four times in the course of our Tables; twice before B.C. 728, and twice after that date. On the two first occasions of this kind, the Cyclical Thoth was still lower than the Nabonassarian in the same Julian notation of each; and therefore it came to January 1 and December 31, each in the course of the same Julian year, before the Nabonassarian Thoth did so. On the two later occasions the Nabonassarian Thoth is the lower term of the two in the Julian notation of both: and therefore the coincidence in question happens sooner in the Æra of Nabonassar than it does in the Æra Cyclica. A temporary disturbance and interruption of the parallel succession and reckoning of the two Æras, under their proper Julian exponents respectively, is hereby produced; but it is only temporary; and it disappears as soon as both Thoths have passed through the same state of coincidence with January 1.

SECTION VIII.—*On the reckoning of Feriæ in the equable Æra of each kind.*

A column of Feriæ is attached perpetually to the first day of the Cyclical Thoth, or the Julian date of every year of the æra in Type i, in this same division E; and another to the first day of the Nabonassarian Thoth, or the Julian dates of the years of the æra of Type ii: though not perpetually or from the first, but only from A. D. 225 downwards.

In both these the Feriæ are to be understood to be reckoned according to the primitive rule of the noctidiurnal cycle, viz. from sunset, or 18 hours from midnight; and not, according to the proper Julian rule of the same thing, from midnight. And this should be kept in mind: otherwise it will always appear from the inspection of the Tables as if the Thoths of each kind entered them perpetually on a *feria* of the hebdomadal cycle one number lower in the Julian reck-

oning of such feriæ than that which is actually assigned them.

On comparing these columns of feriæ together, it will be seen that the Nabonassarian ranges *one number* lower than the Cyclical. *This* is the constant test of the truth and consistency of each, and of the preservation of its proper relation to the other perpetually. The explanation of the phenomenon is that, A. D. 225, the first day of the Nabonassarian Thoth entered the Tables in a state of equality to the 28th of the Cyclical Mesore; and *mutatis mutandis* ever after retained that equality to it[h]. Now the feria of Mesore 28 in the course and succession of the same hebdomadal cycle is necessarily one number lower than that of Thoth 1; being in fact always the same with that of Epagomene 5: for there are always seven days in the equable reckoning of such days from Mesore 28 to Epagomene 5; and eight to Thoth 1.

It will be seen too, on inspection and comparison, that the feria of Mesore 28 in Type i, and that of Thoth 1 in Type ii, after A. D. 225, are still always the same; though the Julian date of Mesore 28 in the former, and that of Thoth 1 in the latter, are not the same, except from A. D. 225, the date of the ingress of Period xxxv, to A. D. 365, the date of that of Period xxxvi. It will be seen however that the difference between these Julian dates themselves, from the time when they begin nominally to differ at all, i. e. from the date of the ingress of Period xxxvi, is only that which exists at present between a given Gregorian term, and the corresponding Julian one; a difference which, as we have more than once already observed[i], is perfectly compatible with a real agreement at bottom, especially in the place of both in the order of the hebdomadal cycle. Yet this difference amounts at last to as much as 13 days; by which the Julian date of Mesore 28 in the last year of the Æra Cyclica which enters our Tables, (April 22 at 18 hours,) exceeds the Julian date of the first of Thoth in the last year of the Æra of Nabonassar, which does the same, April 9 at 18 hours. But this is the difference which exists at the same point of time between a given Gregorian and the corresponding Julian date; as our Tables also

[h] Fasti Catholici, i. 643 sqq. Diss. viii. ch. ii. sect. xi. xii: 660. ch. iii. sect. i.
[i] See the note, p. 56.

shew. It is, or will be, the difference of styles, new and old, as they are called, A. M. 6004 A. D. 2000, the last year of our Tables in the Æra Mundana and in the Æra Vulgaris.

It should be remembered then that in each of these columns the succession of feriæ is reckoned from sunset, not from midnight. If this succession in division E is compared with the similar one in division C, it will always be found to be the same with it; only that from A. M. 1 B. C. 4004, to A. M. 4229 A. D. 225, the succession of feriæ in E, attached to Type i of the equable reckoning, is to be referred perpetually to the Julian succession in C: and after A. D. 225 to the Gregorian one of the Fasti: while, as to the succession of feriæ attached to the Nabonassarian Thoths of Type ii, it is to be referred to the Julian succession in C, at all times, exclusively.

There is yet more to be said on this subject: particularly on the simple and obvious, yet withal demonstrative and conclusive, proof of the truth of the hebdomadal cycle of the Fasti, furnished by this succession of feriæ in conjunction with the first day of the Æra Cyclica perpetually: but we purposely reserve it for a future opportunity.

vi.—*Sixth division of the Fasti, or division* F. *Æra Seleucidarum: Æra Græcorum: Æra Rumæa: Æra Alexandri: Æra Dhu'l-karnaim, or Dh'il-karnaim, or Bicornis.*

The sixth division is symbolised by the letter F. It contains the classical æra commonly called the Æra Seleucidarum, though known also by a variety of other appellations, especially in the style of the writers of the east; among which is that of Dhu'l-karnaim or Dh'il-karnaim, the Æra Bicornis, or of "The lord of the two horns:" borrowed, as we believe, from a certain historical fact recorded of Seleucus Nicator, rather than from any thing in the personal history of Alexander the Great, and especially his supposed relation to Jupiter Hammon.

It admits of proof that this æra must have taken its rise B. C. 312, in the Macedonian month Hyperberetæus; and therefore that the proper head or epoch of the reckoning of annual time in terms of this æra was always the Macedonian month Hyperberetæus: so much so that even when Hyper-

beretæus had now become the last month in the calendar, and Dius the first, the æra was still reckoned from Hyperberetæus, though the calendar bore date from Dius. And although B.C. 312 is also the commonly received date of the beginning of the reign of Seleucus Nicator, and therefore of the foundation of the dynasty of the Seleucidæ his descendants; we much question whether this particular æra was connected originally with that epoch: and not rather with that of the foundation of the city Seleucia on the Tigris. The actual reign of Seleucus does not bear date B.C. 312, but some years later: neither did it begin at Babylon, or in Upper Asia, but at Antioch. Into these points however we hope to have an opportunity of inquiring more at our leisure elsewhere.

It is sufficient to observe at present, in explanation of this Æra, that it must have been a lunar æra at first, and reckoned by lunar years, from the first of the lunar month Hyperberetæus; but that it became solar in consequence of the transition of the lunar into the solar calendar[k]: from which time forward it was reckoned from the solar Hyperberetæus. At present, it is to be considered a continuous reckoning of annual Julian time; which, as a general rule, may be assumed to bear date from October 1, B.C. 312. Another epoch indeed is sometimes to be met with; (i.e. in certain of the Oriental writers;) which would be more in conformity to the first and proper date of the æra: insomuch as this other epoch is Sept 1—a Julian term nearer to the first of Hyperberetæus B.C. 312, than October 1[l]. But though there is good authority for this date, we have not thought it expedient to depart from the more generally received rule of reckoning the Æra Seleucidarum from October 1. It enters our Tables therefore on October 1, B.C. 312, at midnight, according to the Julian rule of the noctidiurnal cycle; and its annual date in our Tables ever after is October 1 at midnight also: the sum of the æra which we exhibit therein being 2312. We have already explained[m] that the Æra Græcorum, or Æra Rumæa, (names sometimes given to this

[k] See our Fasti, vol. i. 602—607. ch. iv. sect. vii. Diss. vii. ch. v. sect. iii.

[l] See our Fasti, vol. ii. 467. Diss. xii.

[m] Supra, pag. 12.

æra also, though improperly,) differs in defect from this perpetually by unity; but in other respects it is the same with it.

vii.—*Seventh division of the Fasti, or division* G. *Æra of Indiction:* Ἰνδικτιῶνος *or* Ἐπινεμήσεως.

This seventh division is denoted by the letter G. It comprehends the Æra of Indiction; a continuous reckoning of Julian years in cycles of 15 at a time: so called *ab indicendo*; from the *settlement, publication,* and *notification,* in one word *Indiction,* at stated times of fiscal arrangements, and fiscal exactions: the taxes, the tributes, the dues of whatsoever kind, which under the emperors were claimed by the imperial exchequer.

Chronologers hitherto seem to have regarded the date of this æra as a very doubtful point; only that it must be comprehended within certain limits, such as the beginning of the reign of Constantine the Great, and the end of the reign of his son and successor Constantius. In our own opinion, the cycle of Indiction is to be considered the lineal representative of a much more classical and much older cycle, the Lustral cycle of ancient Rome, which entered three times perpetually into this. Nor are authorities wanting which expressly assert this fact. In this case, the beginning of the cycle of Indiction goes back virtually, if not actually, to that of the Lustral cycle; which was B. C. 552, in the reign of Servius Tullius. We have traced the different changes of this more ancient cycle, among our other inquiries into the old Roman calendar; down to the time when it finally passed, as we believe, into the cycle of Indiction: which time we think is to be dated in the 7th year of Constantius, A. D. 343 [n].

[n] In the Corpus Inscriptionum Græcarum, tom. iii. P. xxix. p. 325, Introductio. mention is made of a papyrus found at Elephantine in Upper Egypt, (ap. Young, Hierogl. No. xlvi) which bore date Jan. 12, A. D. 355, in the reign of Constantius, and Indiction xiii. This is probably the earliest date in terms of the æra of Indiction, which has yet come to light: though, in strictness, Indiction xiii, according to the common rule, would begin Sept. 1 A. D. 355; and Jan. 1 A. D. 355 would be more properly Indiction xii than xiii. Possibly the date xiii is in error for xii: or the Indiction itself in this instance was reckoned from Jan. 1, (according to the Roman Calendar,) or from March 31, (the first day of the Julian calendar of Upper Egypt, see our Fasti, vol. iv. 213–261. Diss. xvii. ch. iii.), not from Sept. 1, A. D. 343.

In point of fact however, it has long been agreed that there have always been various reckonings of this æra, and from different epochs; which corresponded only in the length of the cycle adopted by each: that being uniformly this particular cycle of 15 years. The principal styles of this kind are the Constantinopolitan, dated from Sept. 1; the imperial or Cæsarean, dated from Sept. 24; and (from the time of pope Gregory VII downwards) the Roman or Pontificial, dated from December 25 or January 1. The most authentic is that of Sept. 1 A. D. 313; and this is the date which we have adopted in our Tables, and from which the æra is reckoned therein perpetually: though, if we are not mistaken in the conclusion proposed above, even this must be considered to anticipate 30 years, or two cycles, on the true date of the æra itself. The earliest date, distinct from this, is A. D. 312; the latest A. D. 315: and it is found reckoned from A. D. 314 between these two, as well as from A. D. 313. The sum of this æra in our Tables amounts to 113 of its proper cycles. As an actual reckoning of time, and in this form, we cannot consider it to have had any existence before A. D. 343. As a mere measure of duration, it may be carried back to any distance: in which capacity, (as we have already explained,) and for which purpose, it enters into the Julian period of Scaliger; and goes back proleptically as far as B. C. 4713.

viii.—*Eighth division of the Fasti, or division* H. *The Æra of Hej'ra.*

The eighth division is marked H; and contains the Arabian Æra of Hej'ra, i. e. "The Flight." We have borrowed this Æra, for the use of our own Tables, from the French work, entitled "Art de vérifier les dates"; taking care only to verify it as we proceeded, and to satisfy ourselves of its accuracy: which gave us almost as much trouble, as the calculation of the Æra itself, from the first, would have done.

This æra is not older than A. D. 622: nor, in fact, so old. It was only in the reign of the second Khalif Omar, (and comparatively late in his reign,) that the epoch, from which the æra takes its name, was assigned it; viz. the date of the

event denoted by Hej'ra or "The Flight;" i. e. the escape or retreat of Mohammed from Mecca to Medina, A. D. 622: while as to the calendar reckoning attached to the æra in its present artificial or technical form, it is 200 years younger than the epoch of the æra, A. D. 622. And in our opinion, having been purposely completed in all its details against that time, by the astronomers of the Khalif Al-Mamoun at Bagdad, it was made public and brought into use at the beginning of the 8th cycle, reckoned proleptically from the epoch of the Æra, Hej'ra 211, A. D. 826.

This æra is strictly a lunar one. No year in the style of Hej'ra contains either more or less than twelve lunar months, reckoned according to the rule of the calendar; i. e. from phasis to phasis, rather than from conjunction to conjunction, perpetually: and none contains either less than 354 days and nights, or more than 355. It has a cycle however, peculiar to itself; a cycle of 30 years of the æra, and of 360 calendar months of the standard of the æra. This standard was purposely assumed by the authors of the calendar at 29d. 12h. 44m. of mean solar time exactly; no regard being paid to any fraction of such time, in seconds or parts of seconds, which ought to have entered it besides: because no such fraction of mean solar time which could possibly have entered into any standard of the mean lunar month, of the time of the authors of this calendar, would have been liable to accumulate to a day and a night complete in less than 2000 years.

The annual reckoning of the Hej'ra then, that is, every 12 of its months in sequence, contains 354 d. 8 h. 48 m. of mean solar time: and did it contain 354 days and nights exactly, each cycle of 30 years would be completed in 10620 days. But in reality 30 lunar years, or 360 lunar months of the standard of the æra, contain 10631 days; that is, 11 days more than 10620: and these are consequently the supernumerary or intercalary days of the calendar, in every cycle; distributed, according to the positive rule laid down by the authors of the calendar, among the 2d, the 5th, the 7th, the 10th, the 13th, the 16th, the 18th, the 21st, the 24th, the 26th, and the 29th years of the cycle respectively. And as these are adopted as the intercalary years of the

cycle in the Art de vérifier les dates, they are the intercalary years in the æra of Hej'ra in our Fasti also: and the asterisk, prefixed to such years, points them out perpetually.

The rule, to which we have referred, was however so far ambiguous, and of doubtful application, that, according to the strict letter of the rule, the 15th year of the cycle had just as good a right to be intercalary, as the 16th: and in the style of the Arabian astronomers the 15th, and not the 16th, year of the cycle is the regular intercalary year at that period of its decursus. Besides this too, the astronomical epoch of the æra of Hej'ra itself differs by one day from the common or vulgar one which we have adopted after the Art de vérifier les dates; the former being July 14 at 6 P. M. or July 15 at midnight, A. D. 622, the latter July 15 at 6 P. M. or July 16 at midnight. The astronomical reckoning of the æra, *in annis expansis*, may be seen in the tables of Gravius, which accompany his edition of the Epochæ Celebriores of Ulugh Beigh[o]. It is easy therefore to compare this with the vulgar or popular, which we exhibit in our Tables. The former should differ by one day from the latter, in every year of the cycle, except the 16th: and in that it should agree with it, at least from the first day of the 16th year to the 354th inclusive.

The lunar calendar of the Arabians, older than Hej'ra, was different from this of Hej'ra: and yet the latter was derived from the former[p]. The names of the months also in the calendar of Hej'ra are older than the æra of Hej'ra. The order of these months too, in the more ancient calendar, was different from that of this. At present Moharram is the first month: originally it was the third. We exhibit these names and this order, as they have always stood in connection with the æra of Hej'ra: premising that the months themselves are alternately 30 and 29 days long, not 29 and 30; and that, in the intercalary years of the cycle, the supernumerary day is given to the last month of the calendar, which in such years becomes a month of 30 days, but in all the rest is one of 29.

o Londini, 1650. 4to.
p See our Fasti, i. 677. Diss. viii. App. ch. i. sect. iii. art. ii.

Lunar Calendar of Hej'ra.

Order, names, and length of the months.

Order.	Names.	Length.
i	Moharram	30 days
ii	Safar	29 —
iii	Rabia el Awal, Prior or former	30 —
iv	Rabia el Akhir or El Tsani, Posterior or latter ..	29 —
v	Jomada el Awal, Prior or former	30 —
vi	Jomada el Akhir or El Tsani, Posterior or latter	29 —
vii	Rajeb	30 —
viii	Shaaban	29 —
ix	Ramadân	30 —
x	Shawâl	29 —
xi	Dhulkaadah	30 —
xii	Dhulhajjah	29 or 30

The column of feriæ, which enters this division of the Tables also, is a necessary complement of the calendar of Hej'ra; because of the use which the Arabian writers themselves constantly make of the hebdomadal cycle, by specifying therein and characterising thereby almost all their dates. The Arabian nightday is reckoned from sunset to sunset, in conformity to the primitive rule; and in the usage of the common people always has been[q]: these feriæ of Hej'ra, in the Art de vérifier les dates, like the Julian dates to which they are attached, are reckoned according to the Julian rule, from midnight to midnight. And though we should have preferred a reckoning, both of the calendar Julian dates of Hej'ra and of their proper feriæ also, more in conformity to the actual rule of the Arabians; we have not thought proper to disturb the arrangements of the Art de vérifier les dates in these respects.

It will appear, on inspection, that these feriæ rise five numbers higher every cycle of 30 years of Hej'ra; and come round to the same order again in every seven such cycles, or

[q] According to Mr. Ideler indeed, the scientific Arabians, who make use of the Coptic, the Syrian, and the Persian calendars respectively quite as much as of their own of Hej'ra, sometimes also, (though not always,) accommodate their reckoning of the noctidiurnal cycle to the rule of these calendars, instead of that of their own; i. e. morning. Halma's Ptolemy, vol. iii. Memoir, ut supra, p. 155.

210 years of the Æra. The reason is that, as each cycle contains 10631 days, it must contain 1518 weeks, and five days over of the 1519th. The hebdomadal period of the calendar is therefore seven of its proper cycles, 210 of its proper years. But the lunar dates of the calendar do not come round to the same solar or Julian in that length of time also. There is in fact no solar or Julian period of this form of the lunar calendar; or none of reasonable extent. It is of all the least entitled to the name of a lunæsolar calendar. It acknowledges no law, and observes no prescription, but that of the actual course and succession of the moon, cyclically reckoned according to its own positive rule; i. e. not from conjunction to conjunction, or from opposition to opposition, but from the phasis to the phasis again, perpetually: in which respect it generally agrees to the truth of nature itself.

ix.—*Ninth division of the Fasti, or division* I. *The Æra Persica, or Æra of Yez-de-jerd.*

The ninth general division of the Tables is marked by the letter I. It contains the Æra Persica; sometimes called (but improperly) the Epocha Persica: i. e. the Æra of Yezdejerd, or Yezdejerdica. And this too is only a form of the equable reckoning of annual time, as much as the Æra Cyclica, or the Æra of Nabonassar; only that in the actual shape, in which we first exhibit it, it took its rise at a much later point of time than even the Æra of Nabonassar: viz. A. M. 4636, A. D. 632, Æra Cyclica 4639, Æra Nab. 1380. Yet notwithstanding this, and in reality, this Æra Persica, comparatively so modern in point of date, is only the modern representative of a much more ancient æra, peculiar to Persia too; of which we hope some time or other to give a full account: the antiquity of which is little inferior to that of the Æra of Nabonassar itself. That this more ancient æra was ever connected with such a point of time as the epoch of the Æra of Yezdejerd, and that it has been continued *de facto* down to the present day in the shape of the Æra Persica; must be resolved into a combination of circumstances which cannot now be explained.

The Thoth of this Æra is the first day of the first month in the Persian calendar, both of the time of Yezdejerd and also

at present, wheresoever that calendar is still in use; i. e. the month which is known by the name of Pher-var-dîn-mah: and the first Thoth of this kind was the Julian date of Pher-var-dîn-mah, (only, as reckoned by the Persian rule from 6 A. M.,) June 16 A. D. 632. The tradition connected with the origin of the Æra is *this;* That it took its rise, along with the accession of Yezdejerd to the throne of Persia, in *this* year and on *this* day, the first of Pher-var-dîn-mah, the first day of the first month of the calendar at the time: which day in the Persian style, being sacred to the Supreme Principle in the ancient religion of Persia, from time immemorial was called by *his* name, Hormuzd.

The Persian months in this Æra are 30 days each in length; following the proper equable rule, the same still as at first. They have the five supernumerary days (Epagomenæ or Appendices) of the equable year; which had no distinctive appellation in the Persian calendar at first, of which any thing is known, any more than in any other of the same antiquity. Scaliger indeed affirms[r] that they had the name of *Wahak,* in their proper calendar; but he does not explain where he found this name, nor what it meant. No such name appears in Hyde, who tells us merely[s] they were called by the ancient Persians Pengji Maz-di-ya-sehân, i. e. Pentas sacra, "The Sacred or Holy five" (days.) But it is certain that their most usual denomination among the Persians themselves, at present, is that of Pengja Duzdîda[t]; the meaning of which is the same as that of the Arabic El-Musteraka, the name which the Arabians gave them: and which consequently, it is to be supposed, must have passed to the Persians from the Arabians. The meaning of both is Pentas

[r] De Emendatione, iv. 294 C: Canones Isagogici, lib. iii. cap. xii.: Thes. Temporum, p. 268. We conjecture that this learned man, whose oriental erudition was almost as great as his classical, through some oversight or other confounded a particular name of the fifth epagomene with a general name for the five epagomenæ. Mr. Ideler at least (Ptolemy of Halma, tome iv. p. 206) quotes a list of the epagomenæ from Alfergan, in which all five are designated collectively Enderds-Châhat, (meaning, according to Mr. Ideler, ἐπαγόμεναι, or "tempora insititia," i. e. "intercalary days,") and the fifth in particular, Wahescht, or Wascht. We take this to be the Wahak of Scaliger. It must be admitted however that Scaliger, De Emendatione, loc. cit. has these five names also, somewhat differently written: and in his list the fourth is Wahascht, the fifth Haschnusch: cf. Hyde, De Religione Vett. Persarum, xv. for these names also.

[s] De Religione, xv.

[t] Hyde, loc. cit.

Furtiva: "The Five of Stealth:" the five which might have crept into the calendar at first by stealth, and might have lurked there unseen and unnoticed ever after.

Now, in the more ancient calendar, and according to its proper rule, the place of these Musteraka could never be fixed and stationary for more than a certain length of time at once: but they always followed some one of the months. We shall not digress at present to explain what changes and turns of this kind they had passed through, before the time of Yezdejerd. It is sufficient to state that, at the epoch of his accession, the month which they were following in its turn was Abân-mah, the 8th in order from Phervardîn-mah. They continued *de facto* to follow Abân-mah long after the time of Yezdejerd: but at last, for convenience sake, and in order that the uniform reckoning of the months, from the beginning to the end of the calendar, might not be broken nor interrupted by the intervention of these five days, they were transposed to the end of Esphendârmad-mah, the last month of the calendar both in the time of Yezdejerd and still. The date of this change in their place is known: and they still follow Esphendârmad-mah.

We present our readers here with the scheme of this Persian calendar also, as it is used at present in connection with this Æra of Yezdejerd.

Order, names, and length of the months in the Persian Calendar.

Order.	Names.	Length.
i	Phervardîn-mah or month	30 days.
ii	Ardebehisht —	30 —
iii	Churdâd —	30 —
iv	Tîr —	30 —
v	Murdâd —	30 —
vi	Shahrivâr —	30 —
vii	Mihir —	30 —
viii	Abân —	30 —
ix	Adur —	30 —
x	Dey —	30 —
xi	Béhman —	30 —
xii	Esphendârmad-mah or month	30 —
		360
xiii	Pengja Duzdîda, El-Musteraka } Pentas furtiva	5
		365

The perpetual affix of mah (or month) is attached to these names of the months, to distinguish them, as so applied, from the same terms when used as the names of certain of the days of the month also. In this case, they assume the affix of rouz or rûz, which means day, instead of this of mah or month.

We have assigned a column of feriæ to the Thoths of this Persian Æra also; beginning with the first of the number, the first day of the Æra, June 16 A. D. 632, which in that year fell on the feria 3a or Tuesday. From this radix or epoch of these feriæ they are all to be reckoned agreeably to the usual rule of hebdomadal in equable annual time; but so that each must be supposed to come in and go out of the Tables at 6 A. M. perpetually. The primitive rule of the noctidiurnal reckoning was as common in Persia from the first, as any where else; and we consider it doubtful whether it was ever superseded even in Persia by this other rule, except for religious, liturgical, or ecclesiastical purposes[w]: though it cannot be denied that, from a certain time downwards, the actual rule was to reckon the noctidiurnal cycle from sun-rise; and it is still the rule of the Parsees of modern times. We have inquired however elsewhere into the date and the reasons of this change: and as we trust have explained them[x].

Scaliger observes that as a civil æra the Æra Persica is no longer in actual use in Persia. In our opinion, it was never in actual use in that capacity, or only for a very short time. As an astronomical æra however it has always been of very general use in the east: and even for ordinary purposes, from motives of religion, the Parsees of Kerman and Surate, the modern disciples of the ancient Zerdusht or Zoroaster, appear to have made a point of using it, if not exclusively of any other, yet quite as much as any other.

The sum of this Æra, which enters our Tables, is 1370 years.

[w] See the Fasti Catholici, i. 206. Diss. iv. ch. ii. sect. xii.

[x] Ibid. 349. Diss. v. ch. iv. sect. v. and Appendix to vol. iv. ch. iv.

X.—*Tenth division of the Fasti, or division* K. *The Æra Gelalæa: Æra Melikæa or Regia: Æra Sultani or Sultanensis.*

The tenth of our general divisions is characterised by the letter K. It contains the Æra Gelalæa.

This Æra, in effect and practice, is Julian, proceeding in cycles of four years perpetually, except at stated times; three of which are 365 days long and the fourth 366. And yet it is reckoned, or supposed to be reckoned, perpetually also from a fixed natural term, the natural vernal equinox, called Naurûz or Neurûz in this form of the Persian calendar; the meaning of which term is New-day, or New-year's day.

The first Naurûz or New-day of this description, in connection with the reckoning of this Æra, and in terms of the Julian calendar, was the Julian date of the vernal equinox, for the meridian of Ispahan in Persia, as determined by actual observation, March 15 A. D. 1079; and every year of the Æra, from that time to this, has borne date, or must be supposed to have done so, in terms of the Julian reckoning of natural or tropical annual time, on the Julian date of the same natural phenomenon, for the same meridian, or for that of some other quarter where the Persian court might be residing at the time, similarly determined by observation: or, at the latest, on the Julian date of the next day. An observation of this kind is instituted every year, preliminary to the declaration of the Naurûz; but the Naurûz itself is declared according to a positive rule, sometimes for the same day, sometimes for the day after.

Still this Æra, to all intents and purposes, must be considered a Julian æra. It has its five Musteraka, three years in succession, and its six, every fourth. It differs from the idea of a proper Julian æra only in having a cycle of leap-year which is not always four years in length. In this Æra, at stated times, there are four years in sequence with five Musteraka only, before there is one with six: which in the proper Julian æra is not permitted, though in the proper Gregorian it is. And, as a general rule, this happens once in every 28 or 32 years. The cycle of leap-year in this Æra

consequently cannot agree with that in the Julian, for more than 28 or 32 years, seven or eight cycles of each kind, at a time.

The history of this Gelalæan correction however in all its details is part of the general account of the Persian calendar, which for the present must be reserved; though we hope that in due time we shall be permitted to give it entire to the world: and there are few of the calendars of antiquity the history of which from first to last is more curious and interesting than that of this. The style of the Gelalæan Æra, so far as concerns the use of a calendar, is the same with that of the Æra Persica. The months of the calendar follow the same order, bear the same names, and are of the same length in each. The place of the Musteraka is after the same month at present in each; the last of the calendar in each. The only difference is that the Naurûz of the Æra Persica is perpetually shifting its place in the order of the natural year; that of the Æra Gelalæa is constantly attached to the same natural term, within the limits prescribed by the rule of the calendar at least: and that the Musteraka in the former are never more than five in number, in the latter they are sometimes six. Besides which, there was a difference of 18 days in the reckoning of the calendar dates of this Æra, compared with the same things in the Æra of Yezdejerd, which was purposely introduced from the first. The date of the Æra Gelalæa in terms of the Æra Persica was an. 448: and the 1st of Phervardîn-mah in that year, as our Table shews, was falling on Feb. 25, and therefore the 19th on March 15. And this being the Julian date of the actual vernal equinox, A. D. 1079, it was taken and constituted the first Naurûz or new year's day in the Æra Gelalæa, in the style and under the title of the 1st of Phervardîn-mah in the first year of this Æra; though it was the 19th of Phervardîn-mah in the 448th year of the Æra Persica.

In this Æra too the night-day is properly to be reckoned from sunrise, or 6 A. M. The years of the Æra enter our Tables in their regular order from A.D. 1079 to the end; and their number, in all, is 922. But we have not ventured to specify the proper Julian date of the ingress of each; though it might have been done in repeated instances, in which it

happens to be known from testimony. An observation, as we have explained, of the natural phenomenon of the equinox takes place every year, before the declaration of the Naurûz; and the rule of the calendar is to declare the Naurûz for noon, next before or next after the ingress of the sun into the first point of Aries; whether that is noon on the same day, or noon on the next. But what reliance is to be placed on the accuracy of observations, as made by the Persian astronomers, perpetually? or what can be known every year of the meridian for which they are made? We have thought it best therefore on the whole to date the years of this Æra simply from the vernal equinox, and simply for the meridian of Ispahan; between which and that of our Tables the difference in time is +1 h. 6 m. 12 s. The Solar Cycle of our Fasti in division B will be a general guide to the actual dates of these ingresses, even for the meridian of Ispahan, or for that of any other quarter in Persia; and the technical rule of the Gelalæan Naurûz being once understood, a conjecture may always be formed from this Cycle whether the Naurûz would be declared for the same day, or for the next *.

* The Gelalæan correction of the Persian calendar, which some modern astronomers and chronologers have professed to admire even more than the Gregorian correction of the Julian; and which the French Directory considered the fittest to be selected, in 1792, as the model and pattern of the calendar of their republic; this correction, we say, was altogether the same thing in principle as the Julian calendar of our Fasti. The only difference between them is *this;* That the rule of the Gelalæan requires a new type of the natural year, in terms of the civil, as soon as the difference between natural annual time and civil amounts to a quarter of a day; the rule of our Fasti, not until the difference in question has accumulated to an entire day.

A. D. 1079 the vernal equinox appears to have fallen out, for the meridian of Ispahan, as nearly as possible about the beginning of the Persian day, March 15 at 6 A. M. Mr. Ideler has determined it by calculation to 6 h. 31 m. A. M. The Persian astronomers, who superintended the correction, seem to have resolved on treating this equinox as if it had happened *de facto* just 6 hours later; i. e. at the point of noon: and to have founded on that assumption the peculiar rule of the correction itself, viz. That the civil equinox should always be reckoned from the noon of the day on which the sun actually entered the first point of Aries, and the Naurûz should be declared accordingly.

These astronomers were superior men for their time. They very well knew that the head of the tropical year, and consequently the point of the

xi.—*Eleventh division of the Fasti, or division* L. *The* 60 *years' Cycle and the* 60 *days' Cycle of the Chinese.*

The eleventh general division of the Tables is denoted by the letter L. It exhibits the 60 years' Cycle, and the 60 days'

equinox, in a year which was reckoned by cycles of 365 days and nights of uniform length perpetually, must advance every year by the amount of the epact on what it had been the year before: and therefore, having chosen a time for the introduction of their peculiar rule, when the actual ingress of this year was falling as nearly as possible six hours of mean time, or one quarter of such a day, before noon, they had already provided for the constant application and constant operation of this rule, if not for ever, yet for a very long time to come.

For the necessary effect of this state of the case in the first year of the correction would be that, at the end of this year, the equinox would be falling at noon; at the end of the second year, at sunset; at the end of the third, at midnight: but the civil Naurûz would still be reckoned from noon, the same day, in each of these years, according to rule, alike. The civil Naurûz, in each of these years, consequently would anticipate upon the true; and the civil year, dated from this Naurûz in each of these years alike, would have 365 days, and no more: just as the Julian has, under the same circumstances, in the common years of the cycle of leap-year. Such years would consequently be the common years of the Gelalæan cycle of leap-year too.

At the end of the fourth year, in like manner, the point of the equinox would be found to be falling between midnight and sunrise, and not far from the point of sunrise itself. The equinox of the fifth year therefore would now have gained 24 hours of mean solar time, or nearly so, complete, on the equinox of the first, in the civil reckoning of both alike. This state of the case would call for an intercalary day in the civil reckoning of natural annual time; and yet the continued application and the continued operation of the same rule, as before, would supply that desideratum. For the letter of the rule, even in this case, would require the Naurûz to be declared at noon next after the equinox, in this case too: and that would be the very thing necessary to redress the inequality of the civil and the natural reckoning of annual time, by giving a day more to the former than it would otherwise have: i. e. by making what must have otherwise been the first day in the fifth year the last day in the fourth. It is easy to see then, on this principle, and by virtue of the mere operation of the rule of the calendar, that the fourth year of the correction must have 366 days; while every year before it must have had only 365. This therefore would be as properly the leap-year of the Gelalæan cycle, as the three before it the common years.

The mean or actual natural year however must fall back on the civil even in the Gelalæan calendar, at a certain rate every four years, just as it

Cycle, of the Chinese; which might have been called the proper Æra Sinensis or Sinica, had we thought proper to adopt that title for it.

These two Cycles enter our Tables in conjunction A. M.

does in the Julian: and no contrivance nor precaution of any kind could possibly prevent that. It would be found from actual observation, in the course of time, that the point of the equinox, at the end of the fourth year, was falling on this side of midnight; i. e. between sunset and midnight instead of between midnight and sunrise: and that discovery would be an intimation that the natural reckoning of mean or actual annual time had now lost 6 hours of mean time, or a quarter of a day, on the civil; which was the utmost degree of difference between them which the Gelalæan correction from the first proposed to allow.

What then was to be done in this case? Merely to adhere to the rule, and to apply it literally as before, by declaring the Naurûz for noon on this day, too, i. e. *before* the point of the equinox; instead of for the next day, that is, *after* the equinox—which would give 365 days only indeed to the fourth year of the cycle, and so would make it common *extra ordinem*, but, with no other interruption but that of the order of the cycle until then, would restore the proportion of civil and natural annual time eventually to its first principles. For the effect would be that the next year the equinox would be found between midnight and sunrise; and the Naurûz, according to rule, being to be declared for noon the same day, the year then coming to an end must have 366 days: i. e. the 5th year would thus be a leap-year, instead of the fourth; and a new reckoning of the cycle of leap-year would begin and proceed from this time forward, in and from the second year of the old one, instead of the first.

We apprehend that the above is a correct explanation of the meaning of the Arabian or Persian writers, who tell us that, after being regularly repeated a certain number of times every four years, the intercalation in the Gelalæan calendar was suspended for one year, and renewed again in the fifth year instead of the fourth. With regard however to the actual number of those times; it is a question which involves the first principles of the correction: because it includes that of the standard of the natural year assumed by the authors of the correction. The oriental authorities are divided upon this point; some saying that the rule was to intercalate six or seven times together, and then to stop, others, seven or eight. We consider this latter statement much more likely to be true than the former. The standard of the Gelalæan correction, it is generally agreed among modern chronologers, must have been very much like that of the Gregorian; each of them such as to lose about a quarter of a day on that of the mean Julian year, in 33 or 34 mean natural years[a]: on which

[a] The difference of the mean Gregorian and the mean Julian year is that of 5 h. 49 m. 12 s. and 6 hours: i. e. 10 m. 48 s. In 32 years this accumulates to 5 h. 45 m. 36 s. and in 33 years to 5 h. 56 m. 24 s. In 34 years, to 6 h. 7 m. 12 s.

3348 B. C. 657; and continue together in the Tables from that time to the end. The 60 days' Cycle indeed, as we have explained elsewhere [y], is a few years older than the 60 years' Cycle, which is not older than this year B. C. 657. And this year, B. C. 657, is also the date of the first introduction of the modern lunar calendar of the Chinese, which took its rise on Feb. 16 that year. And as the Cycle of 60 days, though previously in existence, was purposely connected with this calendar from the first, and the sexagesimal character of Feb. 16, the first day of the calendar, was purposely determined to the 30th feria of the Cycle; this was the same thing as purposely constituting Jan. 18 the same year to be the first. Accordingly, in this representation of both Cycles in conjunction which we exhibit in our Tables, Jan. 18 B. C. 657

principle the cycle of leap-year, in such a calendar as the Gelalæan, would require to be changed once in 33 or 34 years. We should be of opinion indeed, that the authors of the correction originally prescribed no rule on this point; but left it to nature, and to observation: merely providing that, as often as the actual equinox should be found to be falling between sunset and midnight at the end of the fourth year of the cycle, then, but not until then, it should be considered time to change the cycle. It has been assumed that there was a fixed rule of this kind; but we confess we have met with no proof of it ourselves: and the Arabian writers, who give such different accounts of the administration of the Gelalæan calendar, it is to be presumed, could have known of no fixed and invariable rule as that which was actually observed. It would not be correct in point of fact to assume that it was administered perpetually on the principle of a succession of cycles of leap-year, 8 in number; the last of which should be a cycle of five years instead of four: though that would suppose a very perfect measure of the natural year itself; viz. one which should lose a day on the mean Julian only in 128 years.

With regard to the other quarters of the tropical year, we are informed that the entrance of the sun into each of those too was to be determined by a particular observation every year, in order that the beginning of the quarter might be declared accordingly on the same day, if the ingress was found to be taking place before noon, for the next day, if it was found to be happening after noon. But we do not think it necessary to say any thing more on these points at present; except merely again to remind our readers of the great similarity between this Gelalæan rule of later times and the old Phœnix rule of the Egyptians: to which we drew their attention at the proper time before. See our Fasti, vol. iii. 244. Diss. xv. ch. ii. sect. v.

y Fasti Catholici, vol. i. 508. Diss. vi. ch. v. sect. iv: 528. sect. xi; cf. vol. i. 367. Diss. v. ch. iv. sect. x: vol. iv. 1–30. Diss. xv. ch. xi.

is assumed and treated as the common epoch or head of both.

It is the Chinese rule to reckon the noctidiurnal cycle from one of our hours before midnight; or thereabouts: and into the origin and probable cause of this rule we have inquired elsewhere [z]. We assume in our Tables that the feriæ of the sexagesimal cycle are to be reckoned perpetually from midnight; i. e. one hour later than their actual date: an assumption which being once known can never occasion any mistake; and may be corrected at any time, if necessary, to make it agree to the truth. The feria of this primary sexagesimal term, so reckoned, Jan. 18, beginning with unity A. M. 3348 B. C. 657, is shewn, in its order, every year, down to A. M. 6004 A. D. 2000. And the sexagesimal character of a given Julian term at the beginning of any Julian year being known; it is easy to deduce from it that of any other Julian term in the course of the same year: and tables might be constructed, adapted to every possible case of this kind, which would require only to be consulted to know this every year.

On the truth and exactness of these sexagesimal dates of both kinds, from B. C. 657 downwards, our readers may place implicit reliance. They will always be found to be verified by the matter of fact, whensoever that test is applied to them. We have marked each cycle of 60 years in its order; but not each cycle of 60 days. XLV of the former enter the Tables from first to last.

It will be seen from inspection that the period of these two Cycles, in conjunction one with the other, and each with the Julian cycle of leap-year, is one of 240 Julian years, the product of 60×4: i. e. four cycles of 60 years, 240 cycles of four years, or of the Julian cycle of leap-year, and (as it is easy to calculate) 1461 cycles of 60 days. But the period of one of these Cycles alone, in conjunction with the cycle of leap-year, viz. that of 60 days, is only 80 Julian years. The Tables will shew that the same sexagesimal feriæ return to the same days of the month and the same years of the cycle of leap-year, every 80 years*.

* The reason is that the sexagesimal feriæ ascend five days every common year of the cycle of leap-year, and six days every leap-year: 21 in all

[z] Fasti, i. 373. Diss. v. ch. iv. sect. xi: and vol. iv. Appendix, ch. iv.

In the reckoning of their Cycle of 60 years in particular, the Chinese have imposed on the credulity of learned men to a degree which might justly provoke a smile; were not the truth and authority of Scripture seriously compromised by it: and that is too grave and important a consideration for levity or indifference of any kind. The truth and authority of Scripture cannot be called in question without very serious consequences to those who venture to doubt of it; especially on such absurd and ridiculous grounds as these. The reader may form an idea of the extent to which this imposition has been carried, by being given to understand that the first cycle, which enters our Tables, and is dated there Jan. 18 B. C. 657, in order to have fallen in, in its proper order of succession, with the pretended notation of such cycles proposed by the Chinese themselves, must have entered our Tables as the thirty-fourth[a]: i.e. the actual reckoning of these cycles, if the Chinese themselves are to be believed, goes back to A. M. 1368 B. C. 2637, 1980 years before A. M. 3348 B. C. 657, and 289 years before the Scriptural date of the deluge itself.

Had the Chinese been content to propose an epoch like this merely on the principle of the *reditus retro*, no one perhaps might have thought it worth his while to find fault with them on that account; or seriously to object to the selection which they had made. But when they gravely obtrude it upon us as matter of fact, and connect it with an actual succession of dynasties and reigns, one as authentic and one as old as another; it is impossible to tolerate so much impudence and so much extravagance, so much assurance and so much falsehood. The true epoch of the Cycle is not a year older than B. C. 657: and their calendar itself, in the form into which it settled at last, and in which it has long been so settled among them, is no older than this Cycle.

in every four years or cycle of leap-year complete. The cycle of 60 enters 6 times complete into the period of 365 or 366: with five days over in the former, and 6 in the latter. Consequently, in 80 Julian years, in which there are 20 cycles of leap-year, these feriæ will have ascended in all, 21 × 20 or 420 days = 60 × 7 or seven cycles of 60 days complete. The same sexagesimal date then must return to the same Julian, and in the same year of the cycle of leap-year, at the end of 80 years.

[a] See Mr. Ideler's Memoir on the Chinese calendar, p. 75. Berlin, 1839, 4to.

Their cycle of 60 days may boast of an antiquity 85 years greater than that of both; though scarcely even of that in its present state: in which it does not go further back than B. C. 657. This is a sufficient degree of antiquity for any reasonable claims which the Chinese themselves have ever been able to produce; but not enough for the gratification of their own inordinate vanity and self-conceit: nor sufficient, we fear, for the blind and besotted prejudices of sceptical but credulous men, (for scepticism and credulity have always gone hand in hand,) who cannot away with the truthfulness and simplicity of Revelation, while they see every thing to admire and every thing to believe in Chinese, or Egyptian, or Hindu, fables and forgeries.

Nor in the reckoning of this Cycle of 60 years are the Chinese consistent with themselves. There are various computations of the kind among them, each of which has the sanction of some one of their learned or other; some of these too much more extravagant even than the above—in selecting which Mr. Ideler no doubt fixed upon that which must be considered the best substantiated and the most authentic of all, if any thing can be called either substantial or authentic, which has really no foundation to rest on, nor any authority to which to appeal, whatsoever. But what was there, it may be demanded, in a case of this kind, to prevent the utmost liberty's being taken with the truth? when all was invention, and all was exaggeration, directed to one single object; that of adding to the antiquity of the nation by adding to this of the Cycle.

It would seem however, as if doubts were entertained among the more judicious and better informed even of this vainglorious nation, respecting the antiquity of the Cycle; doubts which they tacitly admit by using this Cycle as the middle ages used that of indiction, or as we do the hebdomadal cycle: viz. reckoning by it indeed, and dating according to the current years of the cycle, without pretending to specify the number or order of the cycle itself. Now this is what any sensible people would do, who knew that such a Cycle was in use among them, *de facto*, in a certain way; but how long it had been so, either they did not know, or for some reason or other, did not choose to know.

INTRODUCTION TO THE TABLES.

PART II.

CHAPTER I.

On the Lunar Cycle of the Fasti, or the administration and details of the perpetual Lunar Calendar of the Fasti.

WE shall now proceed to explain the structure and details of the Lunar Cycle of our Tables in division D, more particularly than has yet been done; in order to shew by what kind of arrangement and administration of lunar time perpetually the lunar reckoning of these Fasti has been brought down, with so much general truth and exactness, from so remote an epoch as A. M. 1 B. C. 4004, to the present day.

SECTION I.—*Number and names of the Lunar Months of the Calendar.*

In the first place, though there is no such thing in nature as the lunar year, distinct from the lunar periodic month; yet in conformity to the assumptions of all chronologers without exception, and to the *usus loquendi* every where, and (as we may add) with only a becoming deference to the authority of entire nations, or communities of mankind, so many of which in ancient times professed to regulate their civil reckoning of annual time exclusively by the lunar year, and so many of which do so still; we feel it incumbent upon us to consider and speak of every *twelve* mean lunations at one time, and of every *thirteen* at another, reckoned successively in each case from the primary or radical lunar epoch

of the Tables, April 29 at midnight, for the proper meridian, as composing and making up one mean lunar year perpetually; the difference between which and the corresponding mean solar year, or actual Julian year, in mean solar time, shall always be a stated quantity.

To express these months by names of their own, and to discriminate them one from another, we have borrowed the appellations, (though not the order,) of the months in the modern Jewish calendar. These modern names from a certain point of time at least, (i. e. from the time when these names were first imposed on those months at all,) were common to the ancient calendar: and this time was certainly not earlier, and yet not much later, than the return from captivity, B. C. 536. We have had occasion to investigate the truth on this point with as much exactness as was possible: the result of which investigation is to fix the origin of these names, on what we consider sufficient grounds, to B. C. 524.

The order of the months however, in the modern Jewish calendar, has never, in point of fact, agreed with that in the ancient; and *this* distinction between the two should constantly be kept in mind: viz. that Nisan was always the first month in the ancient calendar, Tisri has always been so in the modern; i. e. the *first* in the former was the *seventh* in the latter, and *vice versa.*

Order, names, and length of the months in the Lunar Calendar of the Fasti.

Order.	Names.	Length.	Order.	Names.	Length.
i	Nisan	29	vii	Tisri	29
ii	Jar	30	viii	Marchesvan	30
iii	Sivan	29	ix	Chisleu	29
iv	Thamuz or Tammuz	30	x	Tebeth	30
v	Ab	29	xi	Sebat	29
vi	Elul	30	xii	Adar	30

Intercalary years, xiii Veadar. 30 days.

Section II.—*On the alternation of the Months in the Lunar Calendar of the Fasti.*

In this lunar year of the Fasti, it is assumed that every two months in order, every *δίμηνον* or Bimestre spatium,

containing 59 days and nights of mean solar time complete, are equal to two mean lunations; and that the division of these days between every two of these months in sequence is to be such that one of them shall have 29 of the number, and the other 30.

Chronologers have given the name of *hollow* (κοῖλοι or *cavi*) or of *halt* (κυλλοὶ, *manci* or *mutili*) to lunar months of 29 days; and that of *full* or *solid* (πλήρεις or *solidi*) to those of 30 days: though why a lunar month of 30 days, which is nearly *twelve* hours of mean solar time greater than the mean natural lunar month, should be called a *full* month, and not rather a *superabundant* or *redundant* one, it is not easy to say, unless as the complement of the hollow or defective month in the calendar reckoning of the δίμηνον or double month perpetually; and so far as filling up and completing the just measure of two such calendar months in terms of natural. Such however is the *modus loquendi*, which custom has established in speaking of these distinctions; and it would answer no useful purpose to disturb it at present.

With regard to the order of these *full* and these *hollow* months; it is matter of indifference *per se* what months shall have 29 days and what 30, provided one *hollow* and one *full* month together, or one *full* and one *hollow* one, have no more than 59. We have seen reason however to conclude that in repeated instances of the first transition from the primitive solar calendar of all antiquity to any form of the lunar, distinct from the Apis cycle, (the natural lunar calendar of that primitive solar one, and associated with it from the first[b]), the rule adopted was to give 29 days to the first month, and 30 to the second: so that the odd months in these first lunar calendars of antiquity were commonly always hollow months, and the even months always full. Such at least was the rule in the oldest lunar calendar of this description which ever had an actual existence; the lunar calendar of Scripture, the civil calendar of the ancient Jews in particular[c]: and such, as we hope to demonstrate

[b] Vide the Fasti Catholici, vol. i. 97. Diss. iii. ch. iii. sect. ii.: 559. Diss. vii. ch. iii. sect. i.: iv. 368 sqq. Diss. xviii. ch. ii.

[c] See our Prolegomena, cap. i. pag. 49, 50.

in due time, was the rule in the Hellenic lunar calendar almost without exception at first. We have not hesitated therefore to adopt this rule ourselves: so that the first month in every year of the lunar calendar of these Fasti is a month of 29 days, and the second is a month of 30; and so on, (except in those cases, in which the rule of the calendar itself, in some other respects, requires a different alternation *pro tempore*,) from the beginning to the end of the year.

SECTION III.—*Exceptions to the rule of the alternation of hollow and full months in the Calendar of the Fasti.*

These cases of exception are two in number, but only two. The first is that of the *intercalary* month, which is always an *uneven* month, and yet always a month of 30 days; except at the end of a Cycle or a Period, when it is a month of 29 days.

In every form of the lunar calendar, in which an intercalary (i. e. a *supplementary*) month is required at stated times, it is also requisite that it should be the greatest of its kind; i. e. the greatest or longest which can have place in the constant reckoning of mean or true menstrual lunar time in integral cycles of day and night; which of course is 30 days: except in that instance only in which the very same reason, which makes it a month of 30 days *before*, requires it to be one of 29 days only *now*; of which reason more will be said by and by.

The second case of exception to the rule of alternation is partly the same as this first, and partly different from it. Twelve lunar months in sequence, alternately 29 and 30 days long respectively, make up the sum of 354 days and nights of mean solar time exactly: twelve mean lunations in sequence, of any standard which might be assumed not less than 29 d. 12 h. 44 m. of mean solar time, could not contain less than 354 d. 8 h. 48 m. of mean solar time. There must consequently be a surplus or excess of 8 h. 48 m. of mean solar time, in every twelve mean lunations, over every twelve calendar lunar months limited as above. In three lunar years, this would accumulate to 26 h. 24 m.: and so on in proportion, as long as it should be permitted to proceed and increase, without being taken into account in the calendar

reckoning of lunar time, or being compensated for therein in any manner whatsoever.

Part of this excess indeed is so taken into account and so compensated for, even in the calendar reckoning, by means of the intercalary month; which generally comes in once in three years, and is generally a month of 30 days: and therefore contains 11 h. 16 m. of mean solar time more than the mean lunation itself assumed at 29 d. 12 h. 44 m. only. But still more of it would remain unaccounted for, and lie by or stand over, and accumulate perpetually; were no other compensation but this of the intercalary month provided against it in the calendar reckoning of mean natural lunar time perpetually.

This extra provision is supplied by the lunar BISSEXT: i. e. the recognition and admission of a Bissextile or leap-year, and of a Bissextile or leap-day, in the constant administration of mean or actual calendar lunar time, as much as in that of mean or actual calendar solar in the sense of Julian. The meaning of this is that, both for the reason just pointed out and for others, it has been found absolutely necessary in the administration of calendar lunar time along with calendar solar in the sense of Julian, to give a leap-day at stated times to the former, as much as to the latter: and for the administration of both in conjunction, it is obviously most convenient to give the same leap-day to each, or at the same time to each, if that can be done with propriety, and as long as it can be done with propriety. Consequently, to make the same years Bissextile in the constant reckoning of annual lunar and annual Julian time; the effect of which, in the parallel reckoning of both together perpetually, is much the same as if every Julian year consisted of 365 days, and every lunar one of 354, or every Julian one of 366, and every lunar one of 355. The defect of the calendar reckoning of annual lunar time on the calendar reckoning of annual solar, in the sense of Julian, is thus made to observe the same or a similar proportion in every year of the cycle of leap-year alike, the leap-years as well as the common; and never to be either more or less than a stated quantity, which is technically called the *epact:* 11 or 19 days as the case may be.

This stated addition however of 24 hours of mean solar time to the calendar reckoning of mean lunar time has undoubtedly a tendency to generate an excess of calendar lunar time over mean or true; which, in the course of 19 years, or even in less than 19, if it is not taken into account and retrenched somewhere in the decursus of the cycle itself previously, will accumulate at last to a day. Now this too is done by abstracting a day from some one calendar lunar month, in some one year of the cycle; and so giving it a day less than its usual amount in the reckoning of the calendar till then. The effect of this diminution in the length of the month in question, and at this period of the cycle, makes itself perceptible in a sudden depression of the cyclical date of the first lunar term in the calendar reckoning, as going on until then, next in course; and in a corresponding rise or *spring* of the epact at the end of the year from 11 to 12, which is known to chronologers, from this very circumstance, by the name of the *saltus lunæ;* and, from its including an addition to the same extent to the annual amount of the lunar epact, also by that of the *augmentum lunare.*

The rule then, which will be found to be observed in the lunar calendar of these Fasti, with respect both to the lunar bissext and to the *saltus lunæ,* is this: That as often as the solar or Julian month of February receives an *extra* day, the lunar month of Sebat, which answers in general to February, receives an *extra* day also, except in those years of the cycle in which the *saltus lunæ* is to be taken into account; which, in the first Type of our lunar calendar, is in fact in the last year of the cycle itself. It is to be remembered then that, in the common years of the Julian cycle of leap-year, the eleventh month of our lunar calendar is one of 29 days; in the bissextile years, (except in the case which has just been pointed out,) it is one of 30.

SECTION IV.—*On the Cycle of the Lunar Calendar of the Fasti.*

The explanations of this Calendar which we are now giving are intended first and properly of the first of our lunar Types: and it has been already stated that the cycle, of which we make use to regulate the calendar reckoning of annual lunar

time in that Type, is the cycle of 19 years, called the METONIC, after the name of Meton, its reputed discoverer among the Greeks. The Metonic Cycle of our Fasti however agrees with the proper cycle so called only in the number of years, or number of months, comprehended by it, and in the order of the intercalary years. But we are at liberty to carry this particular measure of annual lunar, or menstrual lunar, time to any distance we please, either backwards or forwards; and if it never consists of more or less than 235 mean lunations, it is entitled to the name of Metonic, and may be designated and distinguished by that name, long before the time of Meton, its reputed author among the Greeks, (though only among the Greeks,) as well as long after it.

Now in this lunar cycle of 19 years, thus composed of 235 mean lunar months perpetually, 12 × 19, i. e. 228, are common or ordinary; the remainder, 235 − 228 or 7, are extraordinary or intercalary. In our own Metonic cycle of this kind, the former consist of 29 and 30 days each alternately; the latter of 30 days each, except in the case of the last of these seven themselves; which is also the last of the cycle, the 13th month of the 19th year of the cycle, the 235th from the first. And this is a month of 29 days only, though every 13th month besides is one of 30.

The reason of this distinction is easily explained. In each of our cycles of 19 years, the number of mean solar days and nights, independently of any addition made to it at stated times by means of the lunar bissexts, stands as follows:

Sum of mean solar time in one Metonic Cycle of the Fasti, independent of Lunar Bissexts.

19 common years of 354 mean solar days and nights			= 6726 days.
6 intercalary months of 30 days	..	..	= 180
1 intercalary month of 29 days	..	..	= 29
235 months or 19 years, as above ..		..	= 6935 days.

The number of mean solar days and nights in 19 Julian years of 365 days only each = 6935 also. Now the addition to each of these sums of mean solar time, which would be made by taking in the number of leap-days in the course of these 19 years, (whether four only or five as might sometimes

be the case), by hypothesis would be the same in both. If then the sum of mean solar time in one of these lunar cycles of 19 years is not to exceed the sum of the same thing in 19 actual Julian years by 24 hours of mean solar time at last; some one lunar month of the cycle, it is evident, must have only 29 days, which would otherwise have 30. And as none is so proper to be the subject of this diminution as the last lunar month of the cycle itself; it is the invariable rule of the calendar reckoning of our Fasti in Type i, to consider and treat the last month in every cycle as a month of 29 days, instead of 30.

Section V.—*On the Intercalary Rule of the Lunar Calendar of the Fasti.*

The order of the intercalary years in the Metonic cycle is of no great importance in itself, provided that there are neither more nor less than seven such years in one cycle; and that they are neither too near to each other in their recurrence, nor too far off from each other. To us however the most natural distribution of these years has always appeared to be that which seems to have been first devised for the use of the octaëteric cycle; a much older form of the lunar cycle than the Metonic any where except among the people of Israel: and which Meton himself, as we shall see hereafter, (if we ever come to treat of the Hellenic calendar,) transferred to the Metonic cycle also.

Now in this octaëteric cycle the intercalary years were the *third*, the *fifth*, and the *eighth*: and these three being constantly repeated in the same complex of *nineteen* years, as often as they can, the corresponding years of the Metonic cycle also are thereby defined and fixed to the *third*, the *fifth*, the *eighth*, the *eleventh*, the *thirteenth*, the *sixteenth*, and the *nineteenth*, respectively. And that these *were* the actual intercalary years of the proper Metonic cycle itself, we hope to prove clearly hereafter; and as it is, it is admitted by many of the learned, though not by all. At present however it suffices to observe that *these* at least are the years which *we* have fixed upon as the intercalary years of our own Metonic cycle; and these are the years which, in the Lunar Calendar of

our Fasti and of Type i, will be found to be intercalary from first to last without exception: being indicated in each cycle perpetually by the asterisk prefixed to them.

As to the seat of the intercalary month among the rest of the months of the calendar; common sense appears to have suggested to men every where, (at least in the first instance,) that its proper place was at the end of the calendar, because at the end of the year: and in the assignation of its position at first, such was the rule adopted in most instances, (though not without exception,) whatsoever changes in its place might afterwards be made. In the lunar calendar of Israel, the sacred calendar, the oldest calendar of its kind in the world, and as we may add, (if perfection be measured by the practical standard of simplicity, usefulness, and convenience, as well as of sufficiency for its proper end and purpose,) the most *perfect* also; its place was always at the end of the year.

And with regard to the name of this month; if the rest of the months of the calendar had *proper* names, distinct from those of number and order only, the general rule in such cases appears to have been to give the intercalary month the name of the month which preceded it: i. e. to call it a second month of the same name as that. Every one, for example, has heard of the second Posideon in the Attic calendar. Posideon was the name of the xiith month, and Posideon second that of the intercalary month, in the lunar correction of Solon; the first lunar correction which superseded the primitive solar calendar any where among the Greeks. In the sacred calendar it followed Adar: and therefore it was called Veadar, i. e. "And-Adar;" an Adar to boot; a second Adar. And in the modern Jewish calendar Ve-adar is still the intercalary month, though it stands in the middle of that calendar at present, instead of at the end as at first: just as the second Posideon did in the Metonic correction of the lunar calendar of Solon.

We have adopted this name of Ve-adar for the intercalary month of our Fasti. Ve-adar is therefore our proper intercalary month; and it should be remembered that Ve-adar in our Calendar is always a month of 30 days, except in the last year of the cycle: and then it is always a month of 29 days.

In the modern Jewish calendar it is often a month of 29 days, and yet not in the last year of the cycle.

SECTION VI.—*On the Lunar Period of the Fasti.*

As lunar years are formed into *Cycles*, so are cycles collected into *Periods*; and as cycles are reckoned by years, so are periods by cycles.

The period of a lunar cycle of any kind is the interval of time for which the cycle may continue to go on, in obedience to its proper rule of administration, and to be repeated perpetually as a constant measure of true mean lunar time in the sense of civil, without standing in need of correction; but after which it cannot go on any longer, subject even to the same rule and administration as before, and yet be the same correct measure of true mean lunar time in the sense of civil, as before.

The Calippic period of four Metonic cycles or 76 mean or actual Julian years was thus excogitated for the correction of the cycle of Meton; and the Hipparchean period of four Calippic cycles, sixteen Metonic cycles, 304 mean or actual Julian years, was similarly devised for the rectification of the Calippic. This is the most perfect period which has yet been discovered, for the regulation of true mean or natural lunar time in the sense of civil or calendar, in constant connection with true mean or natural solar time in the sense of Julian: and therefore we have adopted it, and have incorporated it with our Fasti from first to last. The merit of the first discovery of it, and of the first application of it also to its proper use and purpose, among the Greeks seems to be due to Hipparchus; who himself, as there is reason to believe, calculated and laid down the scheme of new or full moons, through two such periods as these, (i. e. for 600 if not 608 years,) at least.

In the constant use of this period in our Fasti, it is implied and taken for granted that the lunar cycle of our Calendar, constructed as we have described it, and administered in all its details agreeably to the preceding account, is competent to go on correctly for 16 Metonic cycles, 304 mean or actual Julian years; but that, at the end of this time, if it is to continue as true to the moon as at first, it

stands in need of a correction. The next question then is that of the magnitude or amount of this correction; and in order to decide this question we must first of all compare the sum of mean solar time, contained in one of these periods of 304 mean or actual Julian years, and in 16 of our Metonic cycles, respectively.

i.—*Sum of mean solar time in 304 mean Julian years.*

Supplementary Tables of the Fasti.

TABLE XXXI.

Mean Julian years.			
300	=	109 575 d.	0 h.
4	=	1 461 d.	0 h.
304	=	111 036 d.	0 h.

ii.—*Sum of mean solar time in 16 Metonic cycles of the Fasti.*

In one cycle of 19 years, exclusive of bissexts, we have 354 d. × 19	=	6 726 days.
Seven months of 30 days – unity ..	=	209
One cycle of 19 years, exclusive of bissexts	=	6 935 days.
Multiply by		4
Four cycles, exclusive of bissexts ..	=	27 740 days.
19 bissexts, 76 years	=	19 days.
Four cycles, inclusive of bissexts ..	=	27 759 days.
Multiply by		4
Sixteen Metonic cycles, inclusive of bissexts	=	111 036 days.

That is, the sum of mean time in mean solar days and nights, in 304 mean or actual Julian years and in 16 Metonic cycles of the Fasti, is the same; and without any correction of the latter would be the same perpetually.

The next question then which would present itself for consideration is obviously that of the standard of the mean natural lunation, which after all must determine that of the civil; and this is a question, which we had occasion to discuss in our general work: to which we must consequently now refer[d]. It is sufficient to observe in reference to it here that, having assumed the amount of the correction which the Hipparchean period stands in need of at the end of its proper number of mean or actual Julian years to be 24

[d] Vol. i. 65–70. Diss. ii. ch. ii. sect. iii–v. ii. 23. Diss. ix. ch. i. sect. vii.

hours of mean solar time exactly; we obtain the mean lunar standard of our Fasti from the division of this period, reduced to mean solar days and nights but diminished by unity, by the number of mean or actual lunations in 16 Metonic cycles; i. e. from the division of 111 036−1 or 111 035 by 235 × 16 or 3760. The quotient of this division is found to be

29d. 12h. 44m. 2sec. 33th. · 191 489 361 702 127 659

of mean solar time exactly. And this is consequently assumed to be the proper mean lunar standard of our Fasti: and on this our Tables of mean lunar time in terms of mean solar are constructed.

It would be superfluous therefore to prove that 3760 mean lunar months of the standard of the Fasti are equal to 111 035 mean solar days and nights and not to 111 036 perpetually; and therefore that our Calendar must require a correction of a day at the end of every 304 mean Julian years, which = 111 036 perpetually. And yet no exception can justly be taken to our assumption itself as arbitrary, nor any fault found with our principles as hypothetical and not real; for, as we have shewn in the proper place, if there be such a thing as a true *mean* lunar standard at all, i. e. a standard which is just as much opposed to excess at one time as to defect at another, (phenomena constantly exhibited by the actual mean lunar standard of one time compared with that of another,) and therefore which is fixed and invariable from the necessity of the case, it is as likely to be this standard of our Fasti as any.

It may not however be unacceptable to the reader to see the process, by which this standard was obtained, reversed; i. e. to see this amount of 111 035 mean solar days and nights, recovered from 3760 lunar months of the standard of the Fasti. For this purpose, we have nothing to do but to extract the necessary data from our Supplementary Tables.

Supplementary Tables.—TABLE XXV.

Lunar months of the Fasti.		Mean solar time. d.	h.	m.	s.	th.
3000	=	88 591	18	7	39	34 · 468 085 106 382 977
700	=	20 671	9	49	47	14 · 042 553 191 489 361 3
60	=	1 771	20	2	33	11 · 489 361 702 127 659 54
3760	=	111 034	23	59	59	59 · 999 999 999 999 997 84.

SECTION VII.—*Of the error to which the Lunar Cycle of the Fasti is liable, the manner in which it is generated, and the mode in which it is to be corrected.*

The actual standard of our civil lunar month being adapted to the hypothesis that 3760 lunations of the former denomination contain just one day and one night more than 3760 mean natural lunations; it follows that the latter must anticipate on the former at the rate of 1 hour and 30 minutes of mean solar time every 235 lunations, or 19 actual Julian years; and 6 hours of mean solar time, or one quarter of a day and a night, every 940 lunations, or four cycles of 19 years, or 76 mean or actual Julian years: that is, the first actual civil, and the first mean natural, lunation being supposed to have set out in conjunction at the beginning of the first year of the first period of 76 years, on some day at midnight; the 941st mean natural lunation will be found anticipating on the 941st actual civil month, at the beginning of the second period of 76 years, by 6 hours of mean solar time; the former beginning at 18 hours from midnight exactly, or sunset, on the day before; the latter at midnight as before on the same day as at first.

In like manner at the beginning of the first year of the third period of 76 years, the 153d year of the period of 304 years, the 1881st mean natural lunation will be found to be anticipating on the 1881st calendar month by 12 hours of mean solar time; the former now bearing date at 12 hours from midnight or noon the day before, the latter at midnight the same day as before.

At the beginning of the first year of the fourth period of 76 years, the 229th year of the period of 304 years, the 2821st mean natural lunation will be found anticipating on the 2821st civil month by 18 hours of mean solar time; the former now beginning at 6 h. 0 m. 0 s. from midnight the day before, the latter at midnight still, on the same day as at first.

At the beginning of the first year of the fifth period of 76 years, the end of one period of 304 years and the beginning of another, the 3761st mean natural lunation, the first such lunation of this new period of 304 years, will be found to be

anticipating on the 3761st civil or calendar month by 24 hours of mean solar time; i. e. a day and a night complete: the latter still bearing date at midnight on the same day as before, the former at this juncture at midnight on the day before it.

The necessity then of that correction of the civil or calendar reckoning of the true mean lunar time of the cycle and period perpetually, which has been already explained, and at this moment of the common decursus of both the civil and the true in the cycle and period too, must now be self-evident. And as to the mode of administering it,—since it consists in the abstraction of one day and night from the sum total of mean solar time in days and nights which would otherwise be contained in the calendar reckoning of mean lunar time throughout the period; the expedient which naturally suggests itself is to make Adar, the twelfth month of the Calendar, and ordinarily a month of 30 days, in this extreme case, at the end of the period, a month of 29 days: every thing else remaining the same, and going on at the end of the period just in the same manner as at any other time in it before.

It must be remembered then that, in the last year of one of our periods of 304 years, the xiith month in the Calendar is a month of 29 days; though it is an even month, and in every other instance a month of 30 days. Such months, as having one day less than their ordinary complement in their ordinary place in the cycle, in the modern Jewish calendar are called *defective:* as those on the contrary, which have one day more under similar circumstances, are styled *abundant*. The only *abundant* month in our Calendar is Sebat: the *defective* month, properly opposed to that, (bnt only in this extreme case of the last year of the period of 304 years,) is Adar. The xiiith month in the last year of every cycle, (the intercalary month in that year of the cycle,) which has 29 days by rule only in that particular situation, instead of 30, may be called *defective* also, if we please: but not in the same sense as Adar, in this extreme case.

SECTION VIII.—*Recapitulation of the Rules of the Lunar Cycle or Calendar of the Fasti.*

To recapitulate therefore in brief the principles on which this Lunar Calendar of the Fasti has been constructed, or the rules of administration by which it is regulated.

i. Every cycle of the Calendar consists of 19 actual Julian years, and 235 lunations, civil and mean or natural, both alike; to which there is no exception. Every period consists of 304 mean or actual Julian years, 16 cycles of 19 years, 3760 lunations, civil or mean and natural; to which also there is no exception.

ii. In every cycle of 19 years, seven of these years are intercalary; and these intercalary years are the 3d, the 5th, the 8th, the 11th, the 13th, the 16th, and the 19th: to which there is no exception. Every common year of the Calendar consists of 12 months, and every intercalary one of 13; to which there is no exception. The intercalary month comes next to the 12th, and assumes the name of the 12th repeated; to which there is no exception.

iii. In every year of the cycle, the uneven months are months of 29 days, and the even ones are months of 30. To this rule there are three exceptions.

i. In every year of the lunar cycle, which coincides with the leap-year in the Julian cycle of leap-year, (19 times consequently in every 76 years, 76 times in every 304,) an uneven month, the xith of the Calendar, Sebat, is a month of 30 days.

ii. In the last year of every period of 304 years, an even month, Adar, the xiith of the Calendar, is a month of 29 days.

iii. In the intercalary years of every cycle, the xiiith month, (consequently an uneven month,) is a month of 30 days; excepting only that in the seventh intercalary year, the 19th year of every cycle itself, it is a month of 29 days.

SECTION IX.—*Accuracy of the Calendar reckoning of Lunar time so constructed, and so administered.*

On these few rules, which admit of being stated in this simple and intelligible manner, a perpetual Lunar Calendar has been constructed, from B. C. 4004 to A. D. 2077; the accuracy of which, for the whole of the interval of time comprehended by it, within such limits as, in a case of this kind, must be considered to have been prescribed by the nature of things itself, so far as we have yet been able to discover cannot be impeached by the testimony of a single matter of fact. No one indeed can be so unreasonable as to expect scientific precision from a mere civil notation of natural lunar time, which is based upon such positive assumptions as these, That every natural revolution of the moon itself begins and ends at the same time, midnight, perpetually; and That every such revolution, even as the natural lunar month, consists of 29 days exactly at one time, and of 30 exactly at another: a notation too, which in this perpetual digest of lunar time of its own, has no object in view except to serve the most necessary and indispensable purposes of chronology or of history in general. It is sufficient if the actual date of every actual revolution of the moon from conjunction to conjunction, which has ever taken place since the beginning of the lunar movements themselves in connection with the present system of things at least, can be assigned by the help of this reckoning within such and such limits of the truth: i. e. with more of certainty and more of precision, at the beginning of each of its periods and each of its cycles; with less, as the cycle or the period advances towards its consummation: but never with so much indefiniteness, or with so great a deflection from the truth, as shall transgress certain limits which may always be defined even under such circumstances; and which being known, as the limits of the error in this case, may always be made available for the correction of the error itself.

Now thus much, we do not hesitate to affirm, this Calendar is capable of performing, and at all times: so much so that, although in the twenty periods into which it is distributed, from A. M. 1 B. C. 4004 to A. M. 6081 A. D. 2077, 75 200

natural revolutions of the moon from conjunction to conjunction both must be and are comprehended; there is not one, (supposing all things to go on to the end of the last period, as they have done from the beginning of the first,) the date of which may not be known from this Calendar in numbers of instances with an entire conformity to the truth; in others within 24 hours of the truth: rarely and only at stated times within 48 hours of the truth. And this is more than could be predicated of any lunar calendar which has ever yet been contrived for merely civil purposes; excepting perhaps the Hindu, the Japanese, the Chinese, the Siamese, and the modern Jewish: the latter of which in point of subtlety of conception, and artifice of composition, is certainly the most ingenious and the most elaborate thing of its kind that was ever invented; and, as always intended for such and such uses and purposes, could not perhaps have been different from what it is. Yet in point of accuracy, and as the perpetual test and criterion of true lunar time in terms of civil, even this is not superior to ours. While as to simplicity, and intelligibility, and facility of use and application, i. e. for the proper purpose of any such civil reckoning of lunar time in effect and practice, it is greatly inferior to ours.

SECTION X.—*On the Metonic Tables, or perpetual scheme of the Lunar Calendar of the Fasti.*

Nothing more then being necessary for the explanation of the technical details and administration of this Lunar Calendar; this would seem to be the proper place for the exhibition of the scheme of the first cycle of 19 years, and of every one of those 235 lunations which enter into it in order: and one such scheme, it is evident, having been proposed *in annis et mensibus expansis;* it would be competent to serve the same purpose for every cycle which enters the same period of 304 years. The scheme of the first of the number would be the type of all the rest, 15 in number, to the end of the period; the last month only in the first cycle of one such period, as we have already explained, being incapable of representing the last month in the last cycle also, without a special or extraordinary reduction of one day in its length.

But we have given such a scheme of the first cycle of every such period of 304 years, among the Supplementary Tables of the Fasti, which will be found at the end of the present volume: and therefore it is superfluous to introduce even one such cycle here.

This table is the xxiid of the Supplementary Tables, and it is divided into 20 Parts; each of them devoted to a fresh Type of the first cycle of 19 years, in each of the periods of 304 years. The dates of these cycles after the first, it will be observed, proceed in a fixed ratio to that of the first; viz. one number lower in the same Julian notation continually, with the ingress of every fresh period and of every fresh type of the proper cycle of the period. We call this gradual descent of the Julian notation of these periods and cycles perpetually the DECREMENT of the EPOCH, the *Lunar* Epoch of the Tables, from the primary lunar date which enters the Tables to the last: viz. from April 29 at midnight, A. M. 1 B. C. 4004, to April 10 at midnight, A. M. 5777 A. D. 1773. As this decrement amounts to unity in every single period, it amounts to 19 days in all our xx periods collectively; and 19 is the difference of April 29 at midnight, the date of the first period, and April 10 at midnight, that of the last. It is manifest that, as the first cyclical date in every period after the first descends in this proportion on the first cyclical date in the first; so every subsequent date after the first, in every period distinct from the first, both must and does descend in the same proportion on the corresponding date in the first. We have collected these Decrements of the Epoch also, at the beginning of each period after the first, into a table of their own, which is the xxivth, Part i, of the Supplementary Tables: and both this, and Table xxii, with its 20 Parts, after what has been premised, will be sufficiently intelligible without any further explanation.

SECTION XI.—*On Type ii of the Lunar Cycle of the Fasti; and on its relation to Type i.*

It is manifest, after what has been said on this subject already, that, if there is a gradual tendency in the cyclical or calendar dates of every one of our lunar Metonic cycles to get into an error of excess, this excess is and must be

greatest in the last three years of each cycle, from the 16th to the 19th. Because of the rule and administration of the cycle itself, this tendency must go on accumulating to a day and a night in every such complex of 19 years; and it must arrive very nearly at that amount in the 16th year itself: so that the calendar dates in the last three years of the cycle must be almost as much as 24 hours of mean time in advance of the mean lunar dates. And this excess will be doubled in the last cycle of all which enters the same period of 304 years, and at the same period in the decursus of the cycle; not only because the cycle at that period of its decursus, and at all times of the period previously, stands in need of correction to the extent of a day, but because the period itself, which is now approaching to its consummation, has accumulated an excess of calendar on mean lunar time to the same amount. At stated times then, in Type i, it may happen, (or rather it must happen,) that the calendar or cyclical dates will be 48 hours of mean solar time in excess of the mean lunar dates; and these times will be the three last years of every cycle of the period from the 13th to the 16th inclusive. Yet this kind and degree of deviation from the truth is only accidental. If it is known, it is easy to allow for it, and to correct it at any time. At the utmost it is temporary, and sure to disappear at last; in one of its effects, at the beginning of every cycle, in the other, at the beginning of every period.

This latter tendency to get into error, and an error of excess, from the nature of the case could not be guarded against nor prevented by any precaution which might be contrived for the purpose. It must be suffered to continue even to the end of the period of 304 years; and to produce its full effect, before it can be taken into account and redressed. But the other might easily be obviated: and by so simple an expedient as that of merely adopting a different rule of the *saltus lunæ*.

It is evident that this tendency of the calendar dates, in the cycle of 19 years, to gain on the moon more particularly after the 16th year is due to nothing but the positive rule which we have thought it best to adopt with respect both to the lunar bissext, and to the saltus lunæ, in Type i. Did we

choose to suppress a day, or to dispense with a lunar bissext, at the end of the 16th year of every cycle, we should render the last three years of each as perfect a measure of mean lunar time in terms of civil, as the first three, perpetually. We have not considered it advisable to do that in the cycle of 19 years; i. e. in Type i. It would have disturbed the harmony and symmetry of those cycles too much to have done so; and it would have interfered with the positive or technical rule of the administration of those cycles in other respects, more than the end proposed by it, in the removal of a temporary and accidental inconvenience, would have justified.

Here however the second Type of the Fasti in division D, the Hek-kai-dekaëteric in contradistinction to the Ennea-kai-dekaëteric, comes in to supply the omission in the first, and to answer the same end and purpose, by its own proper rule and administration, which could not have been effected in the other without changing both in that. This Type agrees with the first in all essential respects, except this of the *saltus lunæ*. The seat of the *saltus lunæ* in Type ii is after the 15th year of the cycle perpetually, except in the 15th year of the ninth cycle only; in Type i it is after the 19th: i. e. by the rule of Type ii we subtract a day from the proper month in the 15th year of the cycle, except in the 15th year of the 9th cycle; whereas, according to that of Type i, we never subtract one except from the proper month in the 19th year of the cycle.

The cycle of 16 years enters 19 times into the period of 304 years. It is also a measure of the cycle of leap-year; as the cycle of 19 years is not. Having therefore once been adjusted to the Æra Mundana and to the Æra Vulgaris in the same manner as the cycle of 19 years, A. M. 1 B. C. 4004; it is competent to go on along with both these æras ever after, and to be a measure of the cycle of leap-year perpetually as exactly as they are. Consequently the same years, which are solar or Julian bissexts in both these æras *secundum ordinem*, will be lunar bissexts in this cycle *secundum ordinem* in the strictest sense of the terms also; which in the Metonic cycle from the first they could not always be. And the fourth year in each of these æras which would be bissextile being the 15th, (A. M. 15 B. C. 3990, the end of

the year in each instance), and the first in the lunar cycle of 16 years, in which it would be proper to introduce the *saltus lunæ* at all, being the 15th also; we have fixed on this year as the seat of the *saltus lunæ* in this Type, instead of the 16th, perpetually; except in the case which has just been adverted to, the 15th year of the 9th cycle. For, as we observed on a former occasion [e], the tendency of the Hek-kai-dekaëteris in general being rather to fall back even on the mean new moons, than to advance or gain upon them; it requires a day to be given to it *extra ordinem*, at stated times, (i. e. twice in the course of every period of 304 years,) and not one to be taken away from it. And this should properly be done at the end of every 160 years; but it makes very little difference if it is done once at the end of 144 years, and again at the end of 160; both which periods together are equal to 304 years. The rule therefore which we adopt is to administer the first supplementary correction of this kind at the end of the first 144 years of every period; and the second at the end of the period itself: and the mode of administering it in the first instance, which we also adopt, is to suppress the *saltus lunæ* in the 15th year of the 9th cycle; that is to make the 15th year of the cycle bissextile in the 9th cycle of the period, but not in any other.

We have drawn out the first 19 cycles or first 304 years of this Type also, *in annis et mensibus expansis*; which we exhibit in 19 Tables, or 19 parts of one Table, the xxiiird of the Supplementary Tables in general. Some explanations are necessary to make these intelligible: but they may be comprised in a few words.

i. The years of the period of 304 years in this Type, and those of the Æra Mundana, are the same. The same years consequently are leap-years in both. The first column exhibits these years of the period, and those of A. M. from 1 to 304: and the asterisks in it designate the leap-years, bissextile alike both in the Æra Mundana and in this lunar Æra which accompanies it perpetually; except in the case which has been mentioned. As the seat of the leap-day however in the Æra Mundana is at the end of the odd years, not at the beginning of the even years, reckoned from the vernal equi-

[e] Supra, p. 44.

nox continually, (A. M. 3 *exeunte*, for instance, not A. M. 4 *ineunte*,) we prefix the asterisk to every two of these years, an odd and an even one, in sequence.

ii. The second column exhibits the Metonic cycle of 19 years; recurring 16 times in one period of 304 years. The asterisks in this denote the intercalary years in this cycle, which are not perpetually the same as those of the cycle of 16 years.

iii. The third column contains the Hek-kai-dekaëteric cycle; which comes 19 times over in one period of 304 years. The asterisks on the left designate in this too the intercalary years of the cycle; those on the right the bissextile years: in which it must be understood that the xith month in this Type has 30 days instead of 29, just as Sebat in Type i also, under the same circumstances.

iv. The exception to this rule in this Type is that there is no bissext in the 15th year of the cycle, though that is always a leap-year in the Julian reckoning; except once in the 15th year of cycle ix. In the 15th year of the cycle of 16 therefore the xith month is a month of 29 days; except in the 15th of cycle ix, when it is one of 30 days. As a consequence of this distinction, it will be perceived that the cyclical dates of the 16th year of this cycle are one day higher than they would otherwise be; and that, while the stated increment of these dates on the whole of a cycle in every other instance is three days, in the ninth cycle it is four days; and the first date of the tenth cycle is four days higher than the first of the ninth, instead of three.

v. This stated ascent of the dates, three days or four in every cycle of this description, in 19 cycles or 304 years has the effect of advancing the lunar epoch of the Hek-kai-dekaëteris under its proper Julian term, in the calendar reckoning perpetually, 58 days in all above that from which it set out in the first year of the period itself; these 58 days in excess being the product of $19 \times 3 + 1$. The proper number required is 59 days; i. e. a δίμηνον, or double month, one half of which would be 29 days long, and the other 30. But the truth is, as we have already explained, that the Hek-kai-dekaëteris is already in want of another supplementary correction of one day, at the end of the period of 304 years,

notwithstanding the former correction to that amount, at the end of the 144th year of the period. We administer this correction, and at the same time set back the epoch of the cycle to the same state as at first, (which it is necessary to do, to prepare it to go through the decursus of another period of 304 years,) by reckoning the last year of the 19th cycle as a year of eleven months instead of thirteen; and by giving 30 days to the eleventh month itself instead of 29. The xith month therefore in this Type is bissextile in this case too, the last or 16th year of cycle xix: though not in any other of the kind except the 15th year of cycle ix.

By these means one period of 304 years of this second Type of our General Lunar Calendar being drawn out *in annis expansis* and *in mensibus expansis*; it is easily rendered available for every period of the same kind afterwards. Nothing is necessary for that purpose, but the decrement of the epoch at the ingress of every fresh period; which may always be known from Table xxiv, Part i, of the Supplementary Tables; and the year of any subsequent period in the Æra Mundana and the Æra Vulgaris: which also may always be known from our General Tables. Reduce the lunar epoch of the corresponding year to this in the scheme of the first period by the decrement of the epoch; and it will give you the lunar epoch of the year in question in the given period.

Thus, Required the date of the viith month in the 75th year of Period xx, Type ii.

This year, it appears from the General Tables (division D and A), corresponds to A. M. 5851 A. D. 1847.

			h.	m.	s.	
Hence Supplementary Tables, Table xxiii Part iv, Period i year 75,	Epoch, Oct.	15	0	0	0	
Table xxiv, Part i, Decrement of the epoch, at the ingress of Period xx.	—	19				
Period xx 75, A. M. 5851 A. D. 1847.	Epoch, Sept.	26	0	0	0	
Nautical Almanac, new moon, Greenwich, N. S. A. D. 1847.	Oct.	8	21	6	36	from noon
Difference of styles, and meridians;	—	12	+ 2	20	47	
At Jerusalem, old style	Sept	26	23	27	23	
	= Sept.	27	11	27	23*	

* The above comparison indeed shews the calendar date of the 7th month, Period xx 75, of Type ii, 1 day, 11 hours, 27 min, 23 sec. in defect

CHAPTER II.

On the application and uses of the Lunar Calendar of the Fasti.

SECTION I.—*As a perpetual Manual of Lunar time.*

AMONG other obvious uses of a Lunar Calendar like this of our Fasti, one is to serve as a manual of lunar time, year by year, from the beginning to the end of things; in one word as a perpetual almanac: the accuracy of which, within such and such limits, may be implicitly relied on.

Let the lunar dates of this Calendar, as brought down from the first, be compared with those of any modern ephemeris, (for instance, the Nautical Almanac,) for any twelve months in sequence; for example from April A. D. 1836 to April A. D. 1837: and they will be seen to be capable of bearing such a comparison—allowance being only made for their peculiar rule, in contradistinction to that of the Nautical Almanac.

of the true new moon; which is much more than ought to exist between the mean dates and the true, at a given time. But in fact much of this difference is apparent or accidental only; and due to the rule of the calendar in the cyclical reckoning of mean lunar time. If we go back to the head of this 20th Period, A.M. 5777 A.D. 1773, when mean lunar time and calendar, on the principles of our reckoning of both conjointly, were at par; we have, from the first lunation of the first year of the Period to the 7th of the 75th year, 921 mean lunations = 27 197 days, 16 h. 3 m. 11 sec. 29 th. We have the same number of calendar months, distributed as follows.

12 × 74	=	888	=	26 196 days
Intercalary,		27	=	810
14 Bissexts			=	14
		6	=	177
		921		27 197

The first day therefore of the 922d calendar month would anticipate 16 h. 3 min. 11 sec. 29 th. on the first of the 922d mean lunation of the Period; and this would anticipate 19 h. 24 m. 11 sec. 31 th. on the true new moon; an allowable difference under the circumstances of the case. The real difference between the mean lunar time of our Calendar and true mean lunar time A. D. 1802 was one day. See Fasti, iv. App. ch. v. See also the Table, p. 103. in which one day is seen to be the difference between our new moons and the true almost throughout.

		d.	h.	m.	s.	th.
74 calendar months + 2 Bissexts	=	2186	0	0	0	0
74 mean lunations of the Period	=	2185	6	19	8	56
Defect of the latter	=		17	40	51	4

Period xx, iv 7. Epoch, April 4	0	0	0	
Recession in the Period	— 4	30		
April 3	19	30	0	0
Anticipation, 74 mean lunations,	—17	40	51	4
Epoch, year 7, April 3	1	49	8	56

75th mean lunation, Period xx, iv 7.

	New moons of the Fasti, Period xx, cycle iv 7. Calendar moons.			Mean new moons.	h.	m.	s.	th.		New moons, A. D. 1836–1837. Nautical almanac. Reduced from the meridian of Greenwich to that of Jerusalem, and from new style to old style.	h.	m.	s.	
i	Nisan	April 4	29	April 3	1	49	8	56	midn.	April 4	1	24	5	midn.
ii	Jar	May 3	30	May 2	14	33	11	29		May 3	16	27	47	
iii	Sivan	June 2	29	June 1	3	17	14	2		June 2	7	58	5	
iv	Thamuz	July 1	30	June 30	16	1	16	35		July 1	23	9	23	
v	Ab	July 31	29	July 30	4	45	19	8		July 31	13	32	59	
vi	Elul	Aug. 29	30	Aug. 28	17	29	21	41		Aug. 30	3	3	47	
vii	Tisri	Sept. 28	29	Sept. 27	6	13	24	14		Sept. 28	15	49	23	
viii	Marchesvan	Oct. 27	30	Oct. 26	18	57	26	47		Oct. 28	3	55	11	
ix	Chisleu	Nov. 26	29	Nov. 25	7	41	29	20		Nov. 26	15	20	35	
x	Tebeth	Dec. 25	30	Dec. 24	20	25	31	53		Dec. 26	2	7	11	
xi	Sebat	Jan. 24	29	Jan. 23	9	9	34	26		Jan. 24	12	28	35	
xii	Adar	Feb. 22	30	Feb. 21	21	53	36	59		Feb. 22	22	50	11	
i	Nisan	Mar. 24	29	Mar. 23	10	37	39	32		Mar. 24	9	40	59	

SECTION II.—*Comparison of the Lunar Calendar of the Fasti with the most illustrious Lunar Calendars of antiquity.*

No lunar calendar of antiquity has hitherto come under our observation, except the Apis calendar or Apis cycle, the natural lunar cycle of the primitive solar year, which is as old as this of our Fasti, and in point of constant fidelity to the moon can be compared with it. The lunar calendars of the Hindus, the Japanese, the Chinese, the Siamese, and other nations of the east, are very perfect of their kind; but they all came into existence only χθὲς καὶ πρώην in comparison of ours. The modern rabbinical calendar professes to go back to the date of creation, according to its own chronology[f]; but its true date is not much older than A. D. 344 at the earliest. And none of these calendars, whatsoever be the antiquity to which it may lay claim, for its proper

[f] See our Fasti, ii. 115. Diss. ix. ch. iv. sect. xiv. and our Prolegomena, 75, Cap. i.

use and purpose, (the constant reckoning of true mean lunar time in terms of civil,) is superior to ours: and scarcely any, if we except the modern Jewish calendar, is even equal to it.

To demonstrate the superiority which we thus assert in behalf of the Lunar Calendar of the Fasti, by a particular comparison with one lunar calendar of any other denomination after another, would be an endless task; so numerous did actual calendars of this kind in former times become, and so numerous, in one part of the world or other, are they still. The reader, who shall accompany the work which we have undertaken to the end, (if we are permitted to complete it,) will have abundance of opportunities of instituting such comparisons for himself. We hope at least to lay before him proofs of the truth of what we have asserted, in repeated instances; taken from the matter of fact. At present, it may suffice to illustrate it by one or two examples, derived from the lunar calendars of the past.

i.—*The Lunar Correction of Meton.*

The Attic date of this celebrated correction was the first day of the Attic month Hekatombæon, B. C. 432; which, according to the Attic rule of the noctidiurnal cycle, bore date at sunset[g]. The Julian date is determined by a multitude of concurrent proofs to July 15 at sunset according to this rule, July 16 at midnight according to the Julian, the same year. The true new moon of July, B. C. 432, has been calculated for the meridian of Athens, and determined to July 15 at 7.15 P. M.[h]: i. e. as nearly as possible at sunset, the very beginning of the Attic day: and the mean new moon to July 15 13 h. 10 m. from midnight. The primary date of this memorable correction was undoubtedly true to the moon: and almost as much so as was possible.

In the style of our Fasti, its date would be Period xii, Cycle xiii 1, of Type i: Period xii, Cycle xv *5, of Type ii: and the former being now 18 hours of mean time in excess, we should calculate in this instance by the latter. And, according to this Type, the first of the first month at this time

[g] See Fasti, i. 164. Diss. iv. ch. ii. sect. v.
[h] Ptolemy, Halma, iii. Memoir of Mr. Ideler, Recherches, &c. 80.

was bearing date May 17 at midnight: consequently the first of the third month, July 15 at midnight.

The Metonic correction then was not more true to the mean new moon when it was first coming into existence, than our lunar calendar, which had virtually been in existence 3572 years, at this same time. In 19 years from its date of origination however, the former was already 6 hours of mean solar time in excess of the truth; and in 76 years it was 24; or one entire solar day and night. And this tendency of the Metonic correction, upon its own principles, to go on accumulating a day in excess of the truth every 76 years, (whatsoever learned men may have imagined hitherto to the contrary,) as we hope to demonstrate in due time, at Athens at least *de facto* was never redressed: not even after the Calippic correction had been made public.

ii.—*The Calippic Correction of the Cycle of Meton.*

The date of this correction of the Cycle of Meton by Callippus or Calippus, the republication of the same cycle, in an amended form, commonly known by the name of the Calippic Correction, was B. C. 330: and the primary lunar epoch, at that time too, was the first of the same month Hekatombæon in the Attic style, reckoned from sunset according to the proper Attic rule. Its Julian date is determinable to June 28 at 6 P. M. the same year: and the new moon of June this year too has been accurately calculated, and found to fall June 28 3 h. 34 m. from midnight[1]; the mean, June 28 13 h. 7 m. from midnight.

In the style of our own calendar its date was Period xiii, Cycle ii *8, Type i; Period xiii, Cycle ii *11, Type ii: each of which at this time was equally true to the mean new moon, and each bore date March 31 at midnight, B. C. 330. The fourth month therefore in each bore date June 27 at midnight: i. e. one day and 18 hours before the first of the Calippic Hekatombæon, June 28 at 18 hours. But this difference was purely accidental, and due to the rule of alternation in our Types of both kinds; according to which the third month in each is always a month of 29 days, instead of 30. Besides which, in the Metonic cycle, and at that period

[1] Ptolemy, Halma, tome iii. Memoir of Mr. Ideler, Recherches &c. p. 84.

of the cycle at which this Calippic correction must be supposed to have virtually taken its rise; there were as many as three months in sequence, which were months of 30 days*.

The Calippic correction then was not more faithful to the

* The meaning of this is that the dates of the three last months in the cycle of Calippus, in the last year of every cycle of 19 years but the fourth, (in which they were one day higher,) were March 31, April 30, and May 30, reckoned from midnight. In the last year of his period they were April 1 May 1 (exemtile 3) May 30; reckoned from midnight. On this principle his Munychion, B. C. 330, must have been dated proleptically April 1; that is, a day later than our Nisan, March 31. In the corresponding year of every other cycle of his period it would be March 31; the same as our Nisan, B. C. 330.

An exact comparison of the mean lunar time of our tables with that of the first year of the first Calippic period would stand as follows:

		d.	h.	m.	s.	th.
86 mean lunations of our standard ..	=	2539	15	7	39	34
86 calendar months, plus one lunar bissex	=	2539				
		d.	h.	m.	s.	th.
Anticipation of the 87th calendar month on the 87th mean lunation, Period xiii, ii *8, B. C. 330		0	15	7	39	34
Supp. Tables, xxiv, Part ii. Recession of mean lunar time on calendar, in one cycle ..	−		1	30		
Anticipation of the 87th calendar month on the 87th mean lunation, Period xiii, ii *8 ..	=		13	37	39	34
Tabular mean new moon, Period xiii, ii *8		March 31	0	0	0	
Anticipation	+		13	37	39	34
True mean new moon, Period xiii, ii *8, 87th of the period		March 31	13	37	39	34
Three mean lunations		88	14	12	7	40
90th mean lunation at Jerusalem ..		June 28	3	49	47	14
Meridians			−	45	51	
At Athens		June 28	3	3	56	14
	+		10	3	3	46
True mean new moon at Athens B. C. 330		June 28	13	7		

Our mean lunar time then was now anticipating on the true for a given meridian, 10 h. 3 m. It must anticipate more or less at this period of its decursus, because our mean standard was still much less than the true of that time. But to determine how much exactly would require us to calculate the true mean standard of the middle period between B. C. 4004 and B.C. 330, and to proceed as we have done in other cases of this kind: see Fasti, iii. 524. Diss. xv. Ch. ix. sect. vii.: 541. sect. ix.: iv. Appendix. ch. v.

mean new moon, when it first came into being at the time purposely selected by its author, than our own calendar, which was now 3674 years old. In 76 years however the former would be already 6 hours of mean solar time in excess; and in 304 years, 24, or one entire mean solar day. And though the correction of this inherent defect of the Calippic cycle was certainly pointed out and made known by Hipparchus; yet we do not know that it was ever actually applied to it, not even by the astronomers themselves: much less in the civil lunar calendar any where.

iii.—*The Macedo-Hellenic and Macedo-Syrian Lunar Calendars of antiquity.*

The two most illustrious and most generally circulated forms of the Lunar Hellenic Calendar, embodying all the improvement and all the perfection which it had derived first from the Metonic and afterwards from the Calippic correction, were the above two; to which we have seen reason to give the names of the Macedo-Hellenic and of the Macedo-Syrian respectively[k].

Both these took their rise in the same year B. C. 306, and both nominally on the same day, (the first of the same nominal Macedo-Hellenic or Macedo-Syrian month,) in this year, viz. Dius 1: though Dius 1 in one of these styles, even at this very time, differed 29 days or one *mensis cavus* exactly from Dius 1 in the other: in the former answering to Sept. 30 at 18 hours, in the latter to October 29 at 18 hours.

In the style of our own calendar the date of each was Period xiii, Cycle iii *13, Type i, Period xiii, Cycle iv *3, Type ii: the former April 5 at midnight, the latter April 4 at midnight. In the former consequently the first of Tisri the same year bore date Sept. 29 at midnight; and the first of Marchesvan October 28 at midnight: one day and 18 hours in each instance before the Macedonian Dius 1.

The reason of this difference was partly accidental, as in the last instance, and partly resolvable into the peculiar circumstances of these two calendars at the time, which cannot at present conveniently be explained. It may be assumed however that the calendar lunar time of our Fasti was more

k See our Fasti, i. 598–607. Diss. vii. ch. v. sect. iii.

true to the mean of nature at this time than either Dius 1 in the Macedo-Hellenic style, when it was first coming into being, or Dius 1 in the Macedo-Syrian. And this is confirmed by the date of the solar eclipse, which appears in Pingré's Tables, June 3 11.45 A. M. for the meridian of Paris, B. C. 306: from which we obtain a mean conjunction for the same meridian, in September, Sept. 29, 14 h. 41 m. 10 s. 13 th.: and in October, Oct. 29, 3 h. 25 m. 12 s. 46 th. And thus much at present, with regard to the lunar calendars of past time. We pass now to one or two of those which are comparatively modern in their date, and are still in existence.

iv.—*The modern Jewish Calendar.*

The modern Jewish Calendar, as much as our own, professes to derive its origin from the new moon of creation, or, as the rabbis themselves call it, the *Molad Tohu,* the birth or generation (*νουμηνία*) *χάους*, the "new moon of the Inane" or "Void." But the rabbinical date of the creation is B. C. 3761, 243 years later than the truth[l].

This date answers to Period i, Cycle xiii *16, of Type i of our calendar; Period i, Cycle xvi 4, of Type ii: and the former, at this stage of the decursus of the period, being in excess, we reckon in preference by the latter. The primary new moon of the Rabbinical calendar was determined on the principles of that calendar to October 7 at 18 hours: the new moon of the fifth month of our calendar also, Period i, xvi 4, Type ii was October 7 at midnight. There was little difference then between the lunar reckoning of this calendar, in the first year of its decursus, and that of the 244th of ours, at the same point of time.

We agree with Scaliger however, that the actual date of this modern lunar calendar of the Jews was in all probability A.D. 344[m]; and the first day of the first Tisri in this calendar was Sept. 24 at 18 hours, the assumed date of the autumnal equinox that year. Period xv, Cycle v *16, Type i of our calendar bore date March 31 at midnight, A. D. 344: and Period xv, Cycle vi 12, Type ii bore date April 29 at mid-

l Fasti Catholici, vol. ii. 115. Diss. ix. ch. iv. sect. xiv.
m See our Prolegomena, cap. i. p. 71–78.

night. The first of Tisri, reckoned from the former, was Sept. 24 at midnight also; the first of the sixth month (a *mensis cavus* by the rule of the cycle) reckoned from the latter, was Sept. 23 at midnight; only an accidental difference between them *. The lunar calendar of the rabbis then was not more true to the mean new moon in the first year of its first cycle of 19 years, than ours in the 16th of its 229th. In what manner the two calendars proceeded together afterwards, and what is the relation which still holds good between them; we endeavoured to shew by examples produced in our Prologomena: to which we refer the reader[n].

v.—*The Lunar Calendar of Hej'ra.*

The epoch of this celebrated calendar, as we have already explained[o], was purposely attached to the first of Moharram, A. D. 622: not indeed of the actual Moharram of that time, but of the Moharram of the Hej'ra itself, carried back to A. D. 622 Hej'ra 1, from Hej'ra 211 A. D. 826, according to the technical rule of Hej'ra and its reckoning perpetually.

This first of Moharram was determined by the astronomers to July 14 at sunset, or at 18 hours from midnight, the feria 5ª *ineunte;* the mean date of the phasis, A. D. 622: though the common or vulgar epoch of the calendar was assumed a day later, July 15 at 18 hours, the feria 6ª *ineunte.* The true new moon of July, A. D. 622, for the meridian of

	d.	h.	m.	s.	th.
* 185 mean lunations	= 5463	3	47	52	20
185 calendar months, + 4 bissexts ..	= 5464				
Anticipation, Period xv, v *16 of the 186th lunation on the 186th calendar month ..		20	12	7	40
Tabular epoch, Period xv, v *16 ..	March 31	0	0	0	
Table xxiv, Part ii, Recession in the Period	−	6	0	0	
	March 30	18	0	0	0
Anticipation of the 186th lunation ..	−	20	12	7	40
Epoch of the 186th mean lunation, Period xv, v 16	March 29	21	47	52	20
Six mean lunations	+177	4	24	15	19
Epoch of the 192d mean lunation ..	Sept. 23	2	12	7	39

n Ibid. p. 79–84.

o Supra, p. 63.

Mecca, has been calculated by Mr. Ideler, and determined to July 14. 8.14 A. M. mean time; the true mean new moon to July 14 1.11. A. M.[p] The mean phasis then might be attached to July 14 at sunset: the true would be much nearer to July 15 at sunset.

In the style of our own calendar, the date of Hej'ra was Period xvi, iv 9, Type i: Period xvi, v 2, Type ii: the former bearing date April 16 at midnight, the latter April 15 at midnight. From the former we obtain the date of our Thamuz, July 13 at midnight; which is entirely consistent with the astronomical epoch of July 14, one day and 18 hours later, understood of the phasis, but not as dated from the true new moon, but from the mean. This æra then was not more faithful to the moon, A. D. 622, when it took its rise, than our lunar æra 4625 years from its epoch*. Since then this æra has been losing on the mean standard of its own time; while ours has continued as true to that of all times as ever.

SECTION III.—*Historical uses of the Lunar Calendar of the Fasti.* i. *The Paschal Controversies of Ecclesiastical Antiquity.*

The utility of a Lunar Calendar, on the truth of which, (within the proper limits,) reliance may at all times be placed, admits of being illustrated in a variety of ways. For example, in ecclesiastical history the study of the controversy,

		d.	h.	m.	s.	th.
* We have in this instance as before, Per. xvi, iv 9, 99 mean lunations	=	2923	12	40	12	46
99 calendar months+2 bissexts	=	2924				
Defect of the former on the latter, Per. xvi, iv 9			11	19	47	14
			h.	m.	s.	th.
Tabular Epoch, Per. xvi, iv 9		April 16	0	0	0	0
Recession on the Period, Table xxiv, Part ii.		—	4	30	0	0
		April 15	19	30	0	0
		—	11	19	47	14
Epoch of the 100th mean lunation, Per. xvi, iv 9		April 15	8	10	12	46
Three mean lunations		+ 88	14	12	7	40
103d mean lunation		July 12	22	22	20	26

p Ptolemy, Halma, iii. Mémoire sur l'ère des Arabes, p. 8.

which began to be agitated so early and continued to be agitated so long, relating to the celebration of Easter, will derive much light and assistance from a calendar of this kind. That controversy gave birth to a great number of paschal cycles, each of them aiming at the same thing, a fixed and invariable paschal rule; and each of them aiming at it in vain: yet each professing to correct the errors of its predecessors, and each hoping to guard against the recurrence of the same or similar inaccuracies, by a rule of its own.

It is desirable that the student of ecclesiastical history at this period should always have at hand a never-failing standard of true mean lunar time in the civil or calendar reckoning of true; which may enable him both to comprehend the technical structure and details of these different paschal cycles more readily and easily, and also to test and appreciate the accuracy of each. Some of them were briefly considered in our Prolegomena[q]; and were there summarily contrasted with a lunar calendar derived from that of the Fasti, and in principle altogether the same with it. More will probably come under review hereafter; when we may take occasion to analyze them much more in detail, and to examine them much more closely. At present the only case of the kind to which we propose to recur is that of the Christian Easter, and of the Jewish Passover, known from the testimony of Isaac Argyrus: which we considered indeed but did not decide in our Prolegomena[r].

The passage of the Novi Canones Paschales, in which Argyrus speaks of each of these festivals, as they were celebrated by the Christians and by the Jews of Ænos in Thrace, respectively, some fifty years before the time when he was writing the above work, is as follows[s].

Πρὸ χρόνων γὰρ ἐτῶν πεντήκοντα, νέος ὢν ἔτι τὴν ἡλικίαν, ἐγὼ μὲν παρά τινι τῶν Θρᾳκίκων πόλεων διατρίβων, Αἴνῳ καλουμένῃ, εἶδον τότε τοὺς ἐκεῖσε τὴν οἴκησιν ποιουμένους Ἰουδαίους τῇ κʹ τοῦ Μαρτίου τὸ οἰκεῖον πάσχα τελέσαντας· τὸ δὲ καθ' ἡμᾶς ἅγιον πάσχα τῇ κςʹ τοῦ Ἀπριλίου ἐτελέσαμεν, ἀκουλουθήσαντες τῇ

q Cap. i. pp. 67–71.
r Ibid. p. 82. art. v.
s Uranologium, 381 D—E. Isaaci Monachi Computus, xvi.: Ptolemæi Opera, (Halma,) vii.: Isaaci Monachi Computus, cap. vi. p. 115.

ἐν τῷ κανονίῳ τοῦ Ἰουδαϊκοῦ πάσχα διαλαμβανομένη πανσεληνιακῇ ἡμέρᾳ, Ἀπριλίου ιη΄. καὶ τότε μὲν ἐγὼ ἐν ἀπόροις ἐθέμην τὸ πρᾶγμα, μήπω μαθηματικῶν ἁψάμενος λόγων· ὕστερον δὲ τὰς αἰτίας τῶν τοιούτων ἐκ τῆς ἀστρονομικῆς μαθὼν ἐπιστήμης ἔγνων καὶ τοῦτο κατὰ τὸν εἰκότα λόγον συμβάν.

There are three various readings, instead of the date of Easter Sunday here assigned, April 26; viz. April 20, 23, and 24. The former date is doubtless in error. It exceeds by *one* day the latest date of Easter Sunday in the month of April, April 25: and it is not consistent with the date of the lunar 14th, also assigned, the same year, April 18: for that could never be more than seven days earlier than the date of Easter Sunday: so that if the lunar 14th this year, (which is what Argyrus means by the Jewish full moon, the lunar quartadecima,) was April 18, Easter day might possibly be April 25, but could not possibly be April 26. One of these dates then is in error: in which case, we may take it for granted it is this of April 26.

If April 18 however is the genuine reading in that instance; there was but *one* year in the Alexandrine or Dionysian cycle, (the only orthodox cycle at this time,) in which the lunar 14th fell on April 18; viz. the 8th; that of which the Golden Number itself was viii. Now A. D. 1318 the Golden Number was viii: and the Dom. Let. being A, April 18 the lunar 14th was a Tuesday, April 23 the lunar 19th was a Sunday; and therefore, according to rule, Easter day that year. April 23 being one of the various readings for April 26 in this passage, while there is none for April 18; this coincidence, in our opinion, can leave no doubt that the true reading in the former place, for Easter day, is April 23; and that the year was consequently A. D. 1318.

Now this work of Argyrus' appears to have been certainly under his hand in A. D. 1372:* and fifty years *exactly* be-

* That the date of this treatise of Argyrus was A. D. 1372, appears from a variety of intimations.

It is reckoned to be A. M. 6881[a]; which referred to Sept. 1, A.M. 5509 = B. C. 1—A. D. 1, gives A. D. 1372—1373.

October 26 was Tuesday: so it was A. D. 1372, Dom. Lett. D. C.

[a] Ptolemy, vii. cap. i. 87. cf. cap. iii. 95: Uranolog. 362. A .E. iii. 367 B. vi.: cf. Ptolemy, cap. i. 89.

fore A. D. 1372 takes us back to A. D. 1322. The Golden Number that year was xii; the Lunar 14th April 4: and the Dom. Letter being C, April 4 was a Sunday; and therefore Easter day was the following Sunday, April 11. Argyrus then could not have meant this year: nor consequently have spoken exactly, but only in general terms, of 50 years before A. D. 1372; meaning in reality 54.

There is certainly, even on this principle, a difficulty respecting the Jewish Passover, A. D. 1318, thus fixed to March 20. A. D. 1317, cycle lii 5 of their calendar, Tisri 1,

The moon's age on that day was the luna 28[b]. Our Lunar Calendar gives us the same year the new moon of Tisri, Sept. 29 at midnight, and the luna 28 of that, Oct. 26.

Easter, the next year, would be April 17: the lunar 14, April 10[c]. A. D. 1373, Golden Number vi, the lunar 14th was April 10; and the Dom. Let. being B, April 10 was Sunday, and therefore April 17 Easter day.

This year of the world, A. M. 6881, was not leap-year[d]; as neither was A. D. 1373: and Feb. 13 was a Sunday[e]. And that too was the case A. D. 1373.

It is reckoned 38 years from this year 6881 (A. D. 1373) to A. M. 6919 (A. D. 1411): and 81 years more to A. M. 7000[f], the supposed end of the world, (A. D. 1492).

The Ecclesiastical Lunar Calendar, which Argyrus calls the Paschal Canon, was two days in excess at this time, and fast accumulating to three; and Argyrus was not ignorant of that circumstance[g]. He was also aware that the period of 304 years was liable to an error of a day in excess in one such period: and he infers very truly from both these facts that the Canon of his own time could not be less than 304 years old[h]: *Καὶ διὰ τοῦτο εὐκατανόητον ἔσται, ὅτι τὸ κανόνιον, δυσὶν ἡμέραις ἐκπίπτον τῆς κατὰ τὰ Ἰουδαϊκὰ πασχάλια πανσεληνιακῆς ἡμέρας ἐν τοῖς νῦν χρόνοις, πρὸ τδ´ Ῥωμαϊκῶν ἐτῶν συνέστη.* He calculates for himself the Paschal full moon of A. M. 6881 (A. D. 1373), and determines it to April 8 at 3 equinoctial hours after sunrise[i]. There was a lunar eclipse A. D. 1373, March 9, 3 30 P. M. Paris, which would give a mean full moon for the same meridian, April 8, 4 h. 14 m. A. M.

[b] Ptolemy, cap. ii. 90, 92: Uranol. 363 B. 364 B. iv.: Ptolemy, cap. iii. 97: Uranolog. 369 E. 370 A. cap. ix.

[c] Ptol. vii. cap. iv. 103–105: Uranol. 374 A. xi—375 A: cf. 379 C. cap. xvi: Ptolemy, vi. 110.

[d] Ptol. vii. cap. v. 106: Uranol. 375 C. xii.

[e] Ptol. vii. cap. v. 107: Uranol. 376 A–C. cap. xiii.

[f] Ptol. vii. cap. vi. 111: Uranol. 379 E. cap. xvi.

[g] Ptol. vii. cap. vi. 110–112: Uranol. 378 C. 379 B. xvi.

[h] Ibid.

[i] Ptol. vii. cap. vi. 110: Uranol. 379 C. cap. xvi.

if nothing interfered with it, might have borne date Sept. 7 at 6 P. M.; one day and 18 hours later than Elul 1 in our Calendar, Period xviii, ix 1, Type 1, Sept. 6 at midnight: and the Dom. Letter being B that year, Sept. 7 at 6 P. M. was the feria 5ª *ineunte:* one of the feriæ open to the ingress of Tisri in the Jewish Calendar. But if it did not *de facto* bear date on Sept. 7 at 6 P. M. then it could not bear date before Sept. 9 at 6 P. M. the feria 7ª *ineunte;* for both Sept. 8 at 6 P. M. the feria sexta *ineunte,* and Sept. 10 at 6 P. M. the feria prima *ineunte,* would be excluded by the rule *Adu*[t]. If Tisri bore date Sept. 9 at 6 P. M. the feria 7ª, A. D. 1317, Nisan could not bear date March 5 at 6 P. M. A. D. 1318, on the feria 2 *ineunte;* because that would be contrary to the rule *Badu*[t]: March 5 that year, (Dom. Letter A,) at 6 P. M. being the feria 2ª. In all probability then it bore date March 6 at 6 P. M. the feria 3ª *ineunte:* in which case the Passover day would actually be March 20, the feria 2ª; a feria open to it: and so the matter of fact would actually be, as Argyrus says it was.

ii.—*Chronology of Classical History.*

No where however, perhaps, is the utility of a perpetual lunar calendar, which may always be trusted, greater than when taken along with the study of the Greek or the Roman historians, as a clue to the chronology of passing events. We are entirely of opinion, as far as our own experience goes, that an accurate lunar calendar is one of the greatest desiderata to the chronology of classical history. Who would suppose that the date of a lunar dichotomy would contribute as much as any thing to fix not merely the *year,* but even the *day,* of the capture of Troy?

To specify however some of the positive uses of such a calendar, in illustration of history. Military operations by night, or early in the morning, in such and such climates, and at such and such seasons of the year; changes and affections of the air and weather, which sympathize very much with those of the moon; a light night *up to* a certain hour or *after* a certain hour, a dark one after or before; a νὺξ παν-

[t] See our Prolegomena, cap. i. p. 75.

σέληνος at one time, a νὺξ ἀσέληνος at another: these are things of frequent occurrence in the narrative of passing events; and, when submitted to the test of an accurate lunar calendar, they can often be determined even to the *day* and the *hour*. But to determine the times of passing events even to the day and the hour, if possible, no one will say is not the duty of chronology, as auxiliary to history; but rather its proper business, and its greatest and most characteristic achievement, whensoever it can be effected.

There are errors of statement also to be met with in history, which such a calendar will detect and rectify: and there may be doubts, with respect to the true meaning of an historian, and to the true chronology of his accounts, in a particular instance, which it will decide.

We will illustrate this property of such a calendar by one example only at present; Diodorus Siculus' account of the siege of Tauromenium by Dionysius, tyrant of Syracuse, after his rupture with the people of Rhegium. The beginning of this siege is dated by Diodorus before winter, in the year of Eubulides, and he makes it continue as late as the winter solstice[v]: *Προσεκαρτέρει* (sc. ὁ *Διονύσιος*), says he, *τῇ πολιορκίᾳ τὸν χειμῶνα*: and soon after he mentions the solstice and a νὺξ ἀσέληνος, of which Dionysius took advantage to attempt the surprise of the place: *Ὑπερβαλλούσης δὲ φιλονεικίας παρ' ἀμφοτέροις οὔσης, ἔτυχον μὲν οὖσαι τροπαὶ χειμεριναὶ, καὶ διὰ τοὺς ἐπιγενομένους χειμῶνας ὁ περὶ τὴν ἀκρόπολιν τόπος πλήρης ἦν χιόνος. ἐνταῦθα δὴ Διονύσιος .... ὥρμησε νυκτὸς ἀσελήνου καὶ χειμερίου, κ', τ. λ.*

Now since the archontic years, according to the common rule of reckoning them, and according to that which is followed by Diodorus, (as we hope to prove on a future occasion,) do not begin and end alike; and according to the common rule Eubulides would enter at midsummer, B. C. 394, according to the rule of Diodorus, six months earlier: there may be a doubt whether the siege terminated at the winter solstice B. C. 394, or at the winter solstice B. C. 393. And this doubt our lunar calendar will decide.

For B. C. 394, Period xii, cycle xv 1, Type i, the first of Chisleu is seen to have borne date Dec. 10 at midnight: and

[v] Lib. xiv. (85) 87, 88.

the date of the winter solstice at this time, as our General Tables shew, being Dec. 26 *, that must have been the lunar 16th or 17th this year, the day after the full moon of this month, the calendar πανσέληνον: when the night must have been light all through. But the next year, B. C. 393, the first of Chisleu bore date Nov. 29 at midnight; and the winter solstice, Dec. 26, was the lunar 27th or 28th: the first of the days, in every revolution of the moon from the conjunction to the conjunction again, which the ancients assigned to the *interlunium* or *silent moon* [x], during which the old moon was no longer to be seen, and the new moon was not yet visible. This can leave no doubt that the year of this event was B. C. 393, about the winter solstice; and very probably that the date of the attempt of Dionysius itself was the night of Dec. 26 or Dec. 27.

iii.—*Eclipses of the Sun or the Moon.*

And here the subject of discussion itself suggests another use of a calendar like this, in explaining or illustrating allusions to eclipses of the sun or of the moon, which are of frequent occurrence in the later historians, though much more rare in the older ones; which circumstance of distinction however only renders such allusions in the older historians, when they do occur, the more important and valuable.

It is not indeed in the power of a cyclical calendar to indicate the dates of ecliptic conjunctions or ecliptic oppositions; but if the year and the month of an eclipse are known from testimony, it will direct to the new or the full moon, in such a month, within its proper limits: and so far will approximate to the date of the eclipse itself. At least since we have the eclipses of both kinds, which were capable of happening, or

		h.	m.	s.	
* Mean V. E. at Jerusalem B. C. 394	Mar. 28	12	32	24·0	
Three quarters	+ 273	22	21	37·8	
Mean winter solstice	Dec. 27	10	54	1·8	
Equation of the centre, B. C. 420, Table ii, Part ii	.. −	23	46	33·3	
True winter solstice at Jerusalem	Dec. 26	11	7	28·5	mean time.

x See our Fasti Catholici, ii. 501. Diss. xiii. ch. i. sect. viii. note.

are still to be expected to happen, from B. C. 1001 to A. D. 2000, calculated in the Tables of Pingré and Du Vaucel; though our own calendar cannot pretend to throw any light on these dates, they serve all along as tests and criteria of the accuracy of our own lunar calendar. We will mention three cases of this kind, as specimens of many more which might be cited.

i. Firmicus[y]: Cum sol medio diei tempore lunæ radiis quasi quibusdam obstaculis impeditus cunctis mortalibus fulgida splendoris sui denegat lumina: quod Optati et Paullini consulatu (ut de recentioribus loquar) cunctis hominibus futurum mathematicorum sagax prædixit intentio.

This allusion recognises a solar eclipse at noon-day, in the year of Optatus and Paullinus, U. C. 1087 A. D. 334. In Pingré's Tables there is but one solar eclipse this year; viz. July 17 11 h. 30 m. A. M. Paris; 1 h. 16 m. 35 s. P. M. for the meridian of Constantinople: which would agree sufficiently well to Firmicus' designation of the time as *noon*. By our own calendar, Period xv, cycle v 6, Type i, the new moon of Thamuz bore date July 17 at midnight: according to Type ii, July 16 at midnight.

ii. A solar eclipse is mentioned in the Chronicon Paschale[z], xiv kal. Aug. (July 19) A. D. 418, ὥραν η', on a Friday. It appears in Pingré, July 19 11 h. A. M. Paris, 12 h. 46 m. 35 s. P. M. Constantinople, A. D. 418: and the Dom. Letter being F, that day was a Friday. According to our lunar calendar, Period xv, ix 14, Type i, the new moon of Thamuz bore date July 19 at midnight: and according to Type ii, Period xv, xi 6, July 19 at midnight also *.

iii. A solar eclipse is mentioned also in Lydus, De Ostentis[c]: Καθάπερ καὶ ἡμεῖς 'Αναστασίου ἐξ πρόσθεν ἐνιαυτοῖς τῆς

* This eclipse is noticed by Philostorgius also[a], July 19 at the 8th hour of the day, the year in which the emperor Theodosius attained to the age of a μειράκιον. Theodosius was born April 10 or 11, Coss. Fravitta et Vincentio, A. D. 401[b]; and therefore attained to the age of 17 complete, April 10 or 11 A. D. 418.

[y] De Astrologia: lib. i. cap. ii. p. 5.
[z] Pag. 574. l. 13.
[a] xii. 8. 535 B. C.
[b] Socrates, vi. 6. 309 B: Sozomen, viii. 9. 763 C: Marcellinus Comes, Thesaurus Temporum, 37, Ind. xiv.
[c] Pag. 280. l. 18. cap. vi.

τελευτῆς, ἡνίκα τοιαύτη μὲν ἡλίου γέγονεν ἔκλειψις ὡς ἐν ἡμέρᾳ μέσῃ καὶ τοὺς ἀλαμπεστάτους τῶν ἀστέρων διαφανῆναι, τά τε ἀεροπόρα καθάπερ ἐν νυκτὶ μέσῃ καταπεσεῖν. εἶτα τῆς ἐπιούσης νυκτὸς πῦρ ἀνεφλέχθη τοσοῦτον, ὥστε σπινθήρων τὸν ἀέρα γενέσθαι μεστόν.

Anastasius died A. D. 518. There is a solar eclipse in Pingré's Tables six years before that date, A. D. 512, June 29 9 h. 30 m. A. M. Paris, 11 h. 16 m. 35 s. A. M. Constantinople; which answers to the description in Lydus of this at midday. According to our calendar, Period xv, xiv *13, Type i, we have Thamuz 1 June 30 at midnight, Period xv, xvii 4, Type ii, June 29 at midnight.

Again, the dates of lunar phenomena occur in the Μεγάλη Σύνταξις, Magna Compositio, or Almagest of Ptolemy; most of which will probably come under our review on some future occasion, or have done so already. We will specify only two at present; each an observation of the moon in *quadrature*, or as the Greeks expressed it at the *dichotomy:* in these instances, the second dichotomy, when it was 22 or 23 days old.

The first of these was made by Hipparchus, Cal. Per. iii. 52 (or as the text is here to be corrected, iii. 51)[d], i. e. B. C. 128–127; 619 equable years, 314 days, 17 hours, 45 minutes of mean time, from the epoch of the Æra of Nabonassar: that is, Nabon. 620 Epiphi 15 17 h. 45 m. from noon; Epiphi 16 11 h. 45 m. from sunset:

B. C.			h.	m.		Nab.			h.	m.	
129	Sept.	24	0	0	noon	620	Thoth	1	0	0	noon
		334	17	45				334	17	45	
		338	17	45				315	17	45	
		− 334						− 300			
128	Aug.	4	17	45		620	Epiphi	15	17	45	

The date of this observation consequently was August 4, 17 h. 45 m. from noon = Aug. 5, 5 h. 45 m. A. M. B. C. 128. According to our own lunar calendar, Period xiii, xiii 1, Type i, the new moon of Thamuz bore date July 14 at midnight: and according to Type ii it did the same. The 22d of this

[d] Lib. v. cap. iii. 294, 295: cf. 296.

moon therefore was comprehended between Aug. 4 at midnight and Aug. 5 at midnight: and, if Hipparchus' observation was made on the 22d luna, it was made on the 23rd of our Thamuz *ineunte*. And even in that case it is to be considered that our lunar reckoning in the xiiith cycle was now 18 hours in excess*.

The second observation was made by Ptolemy himself[e]; Phamenoth 25, *μετὰ μὲν τὴν ἀνατολὴν τὴν τοῦ ἡλίου, πρὸ ε′ δὲ καὶ δ″ ὡρῶν ἰσημερινῶν τῆς μεσημβρίας*: i. e. as it appears directly after, 885 equable years, 208 days, 18 h. 45 m. from noon, at the epoch of the Æra of Nabonassar: which gives the date, in terms of the æra, Nab. 886, Phamenoth 24, 18 h. 45 m. from noon, Phamenoth 25, 12 h. 45 m. from 6 P. M. Phamenoth 25, 5 h. 45 m. from midnight.

A. D.			h.	m.	Nab.			h.	m.
138	July	20	0	0	886	Thoth	1	0	0
		203	18	45			203	18	45
		223	18	45			204	18	45
	—	215				—	180		
139	Feb.	8	18	45	886	Phamenoth	24	18	45
	—	9	6	45 A. M.					

The observation therefore was made Feb. 9 at 6h. 45m. A.M. A. D. 139. According to our lunar calendar, Period xiv, x 19, Type i, the new moon of Sebat bore date Jan. 18 at midnight; and the xith month, Type ii, did the same. The 22d luna of this month then came between Feb. 8 at midnight, and Feb. 9 at midnight: and if Ptolemy's observation was made at the luna 22[a] it was made on the luna 23[a] *ineunte*,

			h.	m.	s.	th.
* Period xiii, xiii 1, we have the Tabular Epoch,	April	17	0	0	0	0
Recession in the Period, ...		— 18				
True Epoch, ...	April	16	6	0	0	0
Three mean Lunations, ...	+	88	14	12	7	40
Mean new moon of Thamuz, ...	July	13	20	12	7	40
Three quarters, ...		22	3	33	1	55
Second Dichotomy of Thamuz, ...	Aug.	4	23	45	9	35

That is, about 6 hours earlier than the observation of Hipparchus,

[e] Lib. v. iii. 293, 294. cf. 296.

according to our calendar. But our calendar at this time as before was nearly 18 hours in excess of the truth*.

Lastly, in Gaza, De Mensibus, where he is speaking of the possible coincidence of the solar and the lunar Numeniæ on the same day of the calendar month; there is an appeal to a case of this kind, which had happened that very year: 'Επεὶ ἐνίοτε καὶ ἰσάζειν συμβαίνει. οἷον καὶ τῆτες συμβέβηκε, νουμηνίαν ἅμα 'Απριλίου, μηνὸς ἡλιακοῦ, καὶ σελήνης ἄγειν[f].

This work of Gaza's was written A.D. 1470[g]. Period xix, Cycle i 2, Type i, A. D. 1470, the new moon of Nisan is shewn by our Tables March 31 at midnight. Gaza's numenia was a day later, April 1.

CHAPTER III.

On the Solar Cycle of Chronology, on the Hebdomadal Cycle, and on the Dominical Letter.

The Solar Cycle of the Fasti, according to the sense and construction in which and upon which we have already explained the meaning of the terms, is the constant succession of mean natural vernal ingresses, or the constant succession

* With respect to this observation too we have,

			h.	m.	s.	th.
222 mean lunations,	=	6555	19	7	26	48
222 calendar months, + 4 Bissexts,	=	6556				
Anticipation of the former on the latter, ..		0	4	52	33	12
Period xiv, x 19, Tabular Epoch, ..	March	29	0	0	0	0
Table xxiv. P. ii. Recession in the Period,		—	13	30		
True mean Lunar Epoch, Period xiv, x 19,	March	28	10	30	0	0
Anticipation, 222 lunations, ...		—	4	52	33	12
223d mean lunar month, ..	March	28	5	37	26	48
10 mean lunations, ..		295	7	20	25	32
233d mean lunar month, ..	January	17	12	57	52	20
Three quarters, ..		22	3	33	1	55
Second Dichotomy, ..	February	8	16	30	54	15

about 14 hours earlier than Ptolemy's observation.

f Uranologium, 295 C: Gaza, De Mensibus, ix.
g Cf. Ibid. 304 B. xvi: 311 B. C. xx

of mean civil, in the sense of Julian, equinoxes, supposed to be perpetually equated to mean natural. But in the common style and acceptation of chronologers the Solar Cycle means a very different thing; of which too it is necessary that we should give some account, if not for the benefit of our readers in general, (for many of whom such explanations are doubtless superfluous,) yet in order to the more complete illustration, and the better understanding of the principles, structure, and details of our own system of time in particular, in a very important respect.

SECTION I.—*The primary element of time the Cycle of Day and Night.*

We have often had occasion to observe that the ultimate element of every measure of time, (especially of every civil measure in contradistinction to natural,) is the *mean* cycle of day and night; which at a given time and in a given instance is not to be distinguished from the *actual,* though in *theory* it is distinguishable from the actual: the noctidiurnal cycle, measured by the constant succession of the period of *twenty-four* hours of mean solar time. No elementary principle enters into the perpetual reckoning of civil time, but *this;* nor *this* in any form except that of the same or of similar and equal periods of this kind perpetually[g].

In this sense, the course and succession both of natural and of civil time, once begun, has never been interrupted. The cycle of day and night, so measured and so understood, having once been set in motion, has gone on ever since; the *actual* cycle without intermission of any kind, the *mean,* (as the same with the actual,) with *one* interruption, but only *one:* the effect of which on the actual succession of the same kind, previously going on, was to disturb it in no manner whatsoever; and on the parallel succession of mean, which had been accompanying the actual uniformly until then, was to derange or disturb it only for a time and to a limited extent. This interruption, (as we have shewn at large, and as we believe have demonstrated by every kind of proof of

[g] See the Fasti Catholici, i. 47–58. Diss. ii. ch. i: 84–91. Diss. iii. ch. i. sect. iv—vi.

which the nature of the case admitted[h],) was produced by the two miracles of Scripture, which both chronologers and astronomers, through some unaccountable oversight, have hitherto entirely disregarded; as if neither of them ever had an actual existence, or ever affected the principles of their own science in any way whatsoever: the standing still of the sun in the days of Joshua, and the retrogradation of the sun in the time of Hezekiah.

SECTION II.—*The division of time by the Cycle of the Week, as well as by that of Day and Night, a positive institution.*

This primary simple division of time by the cycle of day and night, having once come into existence and once begun to be applied for its proper effect and purpose, it is manifest was capable of no further distinction, derived from itself, except that of number and order; i.e. the distinction of first and last, referred to the constant succession of the cycle itself. In this succession each cycle must be numerically different from the rest; and the place of each in the order of the succession must be different from that of the rest. We can imagine no distinction among the parts of such a succession but this; and this it is evident is only one of number and order, of first and last, referred to the succession itself. The formation therefore of the component parts of such a succession into collections or sums of any kind must be a totally different thing from the simple succession of the parts themselves; and not only different from it in principle, but in the order of time secondary to it, and in point of fact founded upon it. It must presuppose the simple succession, and it must be resolvable into it at last.

We need not hesitate therefore to affirm that, although the distinction and measurement of time by the simple succession of day and night is *natural;* the division of day and night into cycles of seven, and the consequent measurement of time by the week, is *positive:* and yet that both might have come into being together, and neither, in its proper order and in its proper relation to the other, have been separated from it *de facto*, even for a moment. And this is

h Fasti Catholici, i. 237–383. Diss. v: iv. Appendix. ch. i–iv.

in reality the actual state of the case: viz. That the measurement of time by the week in itself is a *positive* institution, yet, as a measure of time in constant connection with the present system of things, it is as *old* as the measurement of time by the cycle of day and night; That both began together on the first day of the Mosaic creation, and both have gone on together, from that day to the present, yet each in obedience to its proper law; That neither has varied from this law, since both began in conjunction, except in the same sense and to the same extent as the other; and yet that each all the time has been a totally different thing from the other, connected with it indeed in point of fact perpetually, yet not necessarily, or from any unavoidable connection of the things themselves[i].

Chronologers give the parts of the hebdomadal cycle, (i. e. of the numerical succession of day and night by cycles of seven at a time,) the name of FERIÆ[k]; but the final end of this distinction of name is only to designate the relation of one of these cycles and its component parts to another, as similar to it and as composed of similar parts: and in each cycle of the kind to point out and fix the proper place of each of the parts in its proper succession. Since there is such a cycle *de facto* as that of the day and night, and such a cycle *de facto* as the hebdomadal, and both are going on *de facto* at once; every cycle of the former kind must be comprehended in some one of the latter: every numerical cycle of day and night must have its proper *feria* in the hebdomadal cycle. What we contend for, and what we are justified by the matter of fact itself in affirming, is *this;* That this has gone on from the first, and in the succession of *actual* day and night and actual feriæ has never been once intermitted; in that of *mean*, as otherwise the same with *actual*, has once (but only once) experienced an interruption. No proposition, relating to the course and succession of time past, may be more confidently laid down than *this;* That there has not been a single cycle of *actual* day and night, since the beginning of the Mosaic creation, which has not

[i] See the Fasti Catholici, i. 384–397. Diss. vi. ch. i. sect. i–iv: 501. Diss. vi. ch. v. sect. i.

[k] Fasti Catholici, i. 418. Diss. vi. ch. ii. sect. iv.

entered into its proper week, and has not occupied its proper feria in that week; nor a single *actual* week which has ever had more or less than seven actual feriæ or actual cycles of day and night. And as it has been found by experience and from observation that, while there are irregularities and inequalities of various kinds in every department of nature, there is something in each also, which is uniform, constant, and always the same with itself; some principle of fixedness and identity in the midst of continual fluctuation and diversity; something consequently, which serves as a perpetual standard of reference for every thing else of the same kind: so is it with respect to time. The measurement of time by the actual cycle of day and night, once begun, has never ceased, nor ever varied; and the measurement of the cycle of day and night by that of the week, once instituted, has never ceased nor ever varied either. The order of day and night in one of these cycles, and the order of feriæ in the other, never has varied: and regarded in this point of view, and in contradistinction to all the other measures of the same kind, either of these cycles, and more particularly the Hebdomadal, may be called the AXIS MAJOR of time.

SECTION III.—*The division of the Cycle of Day and Night by a Cycle of* Feriæ, *not necessarily one of sevens.*

This cycle of *feriæ,* and in the chronological sense which we have just explained, is the order of day and night in the order of the week; i. e. in the constant succession of seven days and seven nights, but no more, at a time. Yet it must be evident on reflection that there is no necessary connection between the simple succession of day and night, and a constant succession of day and night in an order of seven days and seven nights, and no more, at a time perpetually. It is possible to conceive any number of cycles of day and night as following each other in constant succession perpetually. And in reality the investigation of the history of the measures of time in all parts of the world brings to light various successions of this kind, each of which had an actual existence; some less, some greater, than seven; as the cycle of *three* days, the cycle of *five* days, the cycle of *eight* days, the cycle of *ten* days, the cycle of *thirteen* days, the cycle of

fifteen days, the cycle of *twenty* days, and the cycle of *sixty* days; of some of which we have already given a brief account[1], and of all which we shall have occasion to speak more at large, in different parts of our work, if we are permitted to continue and to complete it.

There is nothing in fact to discriminate such other collections, *communis generis*, as these, even from the hebdomadal cycle, except that they have more or less of a common nature than this; i. e. they are greater or lesser measures of the same kind than this; that they had a different origin from this; that they cannot lay claim to an antiquity like that of this; that they never had a sanction nor authority for their use and application, like that of the hebdomadal cycle: very important distinctions in themselves, but, so far as concerns the common relation of all such collections to the simple succession of day and night, and the common use and effect of all as measures of duration of one kind or other in terms of that simple succession; secondary and accidental.

One thing however is to be observed and kept in mind, with respect to all these secondary forms of a common succession alike, that, whether greater or less in themselves, they are all part and parcel of the civil division and civil measurement of time every where. The division of time by the cycle of day and night is natural. The magnitude of the division is a definition of nature; and the continuity of the division is the work of nature. But the division of time by any number of these cycles, greater than unity, is *positive*. The hebdomadal is one such; the nundinal of classical antiquity was another; the sexagesimal of the Chinese, at the present day, is a third: but, whether hebdomadal, nundinal, or sexagesimal, they were all positive institutions of the same kind, and for the same purpose, at first. The only difference between them was that the hebdomadal in particular was a Divine institution or appointment of this kind; the nundinal and the sexagesimal were both human ones. The former went back, for its origin, to the very beginning of time itself in connection with the present system of things; both the

[1] Fasti Catholici, i. 405–412. Diss. vi. ch. ii. sect. i.: 502. Diss. vi. ch. v. sect. ii–iv.

latter were comparatively of recent date. The former, even as a positive institution, had a sanction and an authority to plead, to which no human appointment of the same kind could possibly pretend: and yet in itself, and in contradistinction to what was strictly and properly natural, it was nothing different from any thing of the same kind which emanated from men themselves, and rested on human authority.

Section IV.—*The Civil year only a larger Cycle of the succession of Day and Night.*

We have often had occasion also to observe that the civil year, under every form and every denomination, (whether solar or lunar,) in contradistinction to the natural, is only a larger and more comprehensive cycle of the succession of day and night [m]; and so far is the same thing in general as the hebdomadal cycle itself. The civil year necessarily consists of a certain number of entire cycles of day and night: and while the form of this year, and its proper laws and administration, in a particular instance, continue the same, this number must remain the same also. The natural year is an unit or integer of a particular kind too [n], which continues always the same with itself; but it never did nor ever could consist of a certain number of integral cycles of day and night.

Section V.—*The distinction of an order of Feriæ in the component parts of the Annual Cycle.*

The true point of view however, in which every form of the civil year is to be contemplated, being this of a larger and a more comprehensive cycle of day and night; it follows that there must be a distinction of feriæ in this larger cycle of the year, because there is such an one in the smaller cycle of the week which enters perpetually into this larger one of the year. Every cycle of day and night must have its place first in the order of the hebdomadal cycle; (which is properly its place in the order of feriæ;) and then in the order of the annual, into which the hebdomadal enters. And this order in

[m] Fasti Catholici, i. 89. Diss. iii. ch. i. sect. vi: 497. Diss. vi. ch. iv. sect. xii.

[n] Fasti Catholici, i. 122. Diss. iii. ch. iv. sect. vi.

both must be and is independent of all human appointment and all human concurrence. It is not in the power of man to suspend or divert the succession of one of these cycles in the other, according to the order appointed by nature, or to alter it in any manner soever; no more than that of the cycle of day and night, which enters at bottom into both of them alike. And whatsoever successions of the same kind distinct from these he may form for himself, whether of day and night merely like the hebdomadal cycle, or of days and nights formed into collections intended of years and called by the name of years, in imitation of the annual cycle of nature; the hebdomadal cycle, and this natural annual cycle, and the cycle of day and night will still go on in the same way, both in themselves and in relation to each other, which is agreeable to the original constitution of each in itself, and the original adjustment of each to the other: the hebdomadal mixing itself perpetually with the annual, the noctidiurnal entering alike and at the same time into each of the other two. And this consideration alone (were there even nothing else which could be alleged to the same effect) would be sufficent to prove the absolute impossibility, and therefore the positive absurdity, of any such supposition as that the noctidiurnal cycle having once begun to be measured in a certain way by the hebdomadal, according to the appointment of the Creator, and both in conjunction, by virtue of the same appointment, having begun to enter in a certain way into the annual, they can ever have ceased to do so; they can ever have departed from the relations originally established between them: they can ever have proceeded, from the first day of the Mosaic creation to this, either individually or in conjunction, in any manner which has not been entirely consistent with that in which they began to proceed at first, and which has not been derivable from it, and the necessary consequence of it also.

It is impossible therefore to separate a fixed order and succession of day and night *de facto* from a fixed order and succession of feriæ also, even from the first; and the civil year, even in its proper relation to the natural, being only a complex of cycles of day and night, it is and must be a complex of cycles of feriæ also. The succession of day and night

however is the first thing to be considered even in this case; and the succession of feriæ the next: for every numerical cycle of day and night must find its place in the former before it can find it in the latter; and it must find its place in the latter only by finding it first in the former. And with respect to an order and continuity of both these kinds, one as perpetual as the other, yet one perpetually dependent upon and determined by the other; the Divine mind is competent to survey it all, and to comprehend it all, howsoever long it may have gone on, and howsoever long it may still go on, without confusion, without obscurity, without interruption, in its simplicity and in its integrity, yet in its distinctness and individuality also. And therefore it stands in no need of assistance *ab extra*, no note nor criterion to designate limit and define the succession perpetually, but the mere succession itself. But with the human mind the case is very different. It could not comprehend and take in the numerical parts or units of time, in their totality, even if it could see them all at once: and it cannot embrace at one view more than a very small part of these units at once. It might be possible to follow and count the waves which chase each other over the surface of a lake, or confined piece of water of any kind; but who would undertake to do this over the boundless expanse of ocean? And hence one obvious use of the institution of the hebdomadal cycle, even as made up of parts homogeneous with those which compose the succession of night and day, (an use, on which we have insisted more at length elsewhere[o],) that, without interrupting the continuity of the succession itself, it serves to break up this succession of the simplest and most elementary, and therefore the most exact and perfect, but withal the most indefinite and difficult to follow perpetually, of the measures of time, which we call the noctidiurnal cycle, into parts which are more within the grasp of *our* comprehension. It is easier to reckon the succession of time perpetually by the week than by the day; just as it is by the month than by the week, and by the year than by the month.

In the application then of this most elementary of the forms or modes of time to its proper use and purpose, the

[o] Fasti Catholici, i. 385. Diss. vi. ch. i. sect. ii: 401. sect. v.

measurement of human time, the first principle is That every numerical cycle of day and night must have its own place in the order of its own succession. The next is a consequence of this; That every such cycle, having its own place in the order of day and night, has its own place in the order of feriæ also. These things are inseparably connected; an order of days and nights and an order of feriæ: a fixed order of days and nights and a fixed order of feriæ; the latter, abstractedly considered, a totally distinct thing from the former, and entirely independent of it, yet in point of fact combined with it but subordinated to it: not necessarily a consequence of it, yet, as the case is and always has been, an *actual* consequence of it; not *a priori*, or by virtue of the reason of things, but a *posteriori*, *de facto*, and by virtue of a positive appointment.

And what is thus true both of the simple succession in the first place, and of the simple succession in the shape of feriæ in the next place and through that, must be true of every thing into which the simple succession may enter, or actually does enter, distinct from itself. And if the simple numerical cycle of day and night is the ultimate element of the civil month, or of the civil year; every numerical cycle of day and night, which enters the civil month or the civil year, must carry with it its proper numerical feria into the month or the year also: and there will be a menstrual order of feriæ and an annual order of feriæ, as much as a menstrual or annual order of the noctidiurnal cycle. The week, the month, the year, are only so many different forms of the succession of day and night, which enters them all and runs through them all in the same way, as if independent of each, and as if nothing existed, in the shape of a measure of time, but itself. The week, the month, the year, are secondary forms of the same succession, which differ from the primary by stopping in that periodically, and beginning again; while that goes on without interruption in the same way perpetually. These secondary forms of the same succession have each their proper law. It is one law which makes the cycle of the week out of the simple succession of night and day; another which makes the month, and another which makes the year. Nor can these laws and distinctions be confounded; nor are they

de facto confounded even when all these forms are mixed up and blended together, as they are in the calendar perpetually; and when each is going on along with the rest. Yet that which makes this possible, that which enables them to go on in conjunction, and yet to continue distinct, is the same cycle of day and night which enters in its integrity into them all, and is or may be at one and the same time a constituent part of them all; and may occupy its proper place at one and the same time in all.

Section VI.—*On the absolute beginning of Noctidiurnal in conjunction with Hebdomadal, Menstrual, and Annual Time, derivable from these relations.*

Particular cycles of day and night however being thus distinguished asunder in the general succession of all such cycles, by such various criteria as their place in the order of the general succession, their place in the order of feriæ, their place in the order of the month, and their place in the order of the year; the very fact that such distinctions exist, and always have done, and that numerical cycles of this kind have been and still are perpetually thus discriminated asunder, is a very good argument that this kind of succession cannot have gone on, and in this way, from all eternity: though it may have been going on for any length of time, which to our own finite power of the comprehension of such distinctions at present, may be scarcely distinguishable from eternity itself. But in an eternal succession of this kind (i. e. a succession which never had a beginning) there could be no such distinctions as these; not merely because there can be no distinction of first or last, or of numerical parts at all, in an eternal succession, but because in an eternal succession such things never could have begun to be. It is at least absolutely necessary that a course and succession of things, of which such distinctions hold good, and always have done, should not be regarded as any part of an eternal succession of the same kind; but as a segment cut off from eternity itself, if such a thing can be conceivable: a segment which was finite in itself though part of infinity; a segment of duration isolated from duration itself: which must consequently have had a beginning, and for the same reason might have an end.

And from this view of the case, (the reasonableness of which could not well be called in question,) it might justly be argued that, if time and the different measures whereby it stands connected with the present system of things, (which are only modifications of a common succession,) must thus in reality have had a beginning; these different distinctions in one and the same kind of succession must have come into existence at once. The first term in the actual succession of day and night, the first in the order of feriæ, the first in the order of the month, and the first in the order of the year, (all which together make up the complex of the calendar, or of the civil reckoning of time in all and each of its measures simultaneously,) must have been the same; in which case, and which only, would the entire course and succession of time, in all and each of its parts, not merely set out alike, but ever after continue and proceed alike. And from this very natural and even necessary presumption of the state of the case at first the reader will draw his own inference; That no representation of the entire scheme and succession of time in all its parts, from first to last, can possibly be true of which it does not hold good: and none can be false of which it does.

The practical result of these considerations is That, if we would discover the absolute coincidence of all these different measures of one and the same simple succession, viz. that of day and night, in their proper because their primary state of relation both to this succession and to each other, we must go back to the beginning of things. We may find them coinciding at different points of the succession subsequently: but these will be no cases of coincidence for the first time, but merely of returns to a state of coincidence at certain times again. Successions which are the same in general, and made up of similar parts, having set out in conjunction and in a certain state of relation to each other at first, cannot fail to return to the same state of relation to each other sooner or later afterwards. But the first and proper coincidence is that of *origination:* the circumstances under which these successions set out at first, and the relation in which they stood to each other at that moment of time in particular.

SECTION VII.—*Solar Cycle of the Equable year.*

There is no distinction perceptible in the succession of time as measured by the cycle of day and night, beyond that of the order of the cycle itself. One cycle of day and night, except in its numerical place in the order of the succession, is the same as another. Neither is any perceptible in the succession of time as measured by the week; one week, except in the general reckoning of weeks, and in the numerical order of a particular week, being the same as another. The same observation may be made on the measurement of time by the month and by the year (the civil month and the civil year more particularly); for though these are not always of the same length, there is no reason why they might not be so: in which case, there would be as little to distinguish one civil month, or one civil year, merely as a measure of time, from another, as one day and night from another, or one week from another.

The object which we have in view at present however requires that we should confine our remarks to the civil year, and that too the civil year of our Fasti, which is in other words the solar year of the Fasti; of which we admit into our Tables two kinds, the Equable solar and the Julian. Both these are cycles of days and nights; one of 365 days and nights perpetually, the other of 365 at one time and of 366 at another. Both have been brought down in our Tables from the first, and both from the same day; which was the first both in the actual succession of day and night as it has gone on perpetually in connection with the present system of things, and in the order of feriæ or the constant measurement of the succession of day and night by the cycle of seven, and in the succession of annual time in the sense of the equable year, and in the same succession in the sense of the Julian year: or, what amounts to the same thing, the first in the measurement of the succession of day and night by the equable cycle of that kind, and the first in the measurement of the same succession by the Julian cycle of the same kind. And each having thus set out from the same point of departure, and each having assumed the same nu-

merical unit in a common succession as the radix or base of its proper scheme of the succession ever after, respectively; they have gone on in conjunction ever since, one as exact a type of annual time in the sense of a certain complex of cycles of day and night according to the equable rule, as the other according to the Julian: the succession of day and night itself, and along with it the succession of feriæ, going on all the time alike in each.

A smaller cycle of a certain kind must necessarily measure a greater of the same kind; i. e. enter into a greater of the same kind. The cycle of day and night must enter into that of the week; the cycle of the week into that of the month; the cycle of the month into that of the year. But that a smaller cycle of a given kind by necessarily entering into a larger of the same kind should measure it exactly, that is, enter into it a certain number of times completely, does not follow. It might have been possible, (had the arrangements and details of the civil calendar every where been purposely conformed to such a postulate,) so to assume the larger cycles of a common kind which enter into the calendar, as to make them multiples of the smaller which enter it also. But this has been no where done; and the consequence is *de facto* that the only smaller cycle of the given kind which enters alike into all the larger, and measures them all exactly, is that of which they all ultimately consist, the cycle of day and night; which enters seven times exactly into the hebdomadal, and 365 times or 366 times into the annual: while the next smallest to this, the hebdomadal, enters 52 times indeed into the annual, but falls one day short of measuring it completely in the cycle of 365 days, and two days in that of 366.

It follows that, if the first day of the week coincides with the first day of the equable year in one year; the second day of the week must coincide with the first day of the equable year in the next year, and so on: that is, the first day of the equable year must advance forwards, in the order of feriæ, one term every year; and consequently at the end of seven equable years must again be found coinciding with the first term in the order of feriæ, or whatsoever term in that order it might be from which it set out at first; the order and succession of feriæ itself all the while remaining invariable. For

it is manifest that, under such circumstances, it is the first day of the equable year which is continually ascending one number in a fixed order of feriæ every year, and not the first term in that order of feriæ, which is dropping or descending one number every year, to meet the head of the equable year.

And supposing this process to have begun in this manner at first, and to have gone on perpetually in the same way; it must be evident that the interval of time, which must have brought the first day of the civil year, in the sense of the equable, to the same state of relation to the hebdomadal cycle or cycle of feriæ as at first perpetually, must have been neither more nor less than *seven* equable years: in which there must always have been 365 × 7 or 2555 cycles of day and night, and 365 weeks or cycles of feriæ exactly. And if, in conformity to the language or *usus loquendi* of chronologers, we must give the name of the Solar Cycle to the interval of mean solar time which, under any circumstances, was competent to bring about an effect like that perpetually; the Solar Cycle of the equable year must have been defined as a cycle of seven equable years, and no more, perpetually.

Solar Cycle, or Sunday (Dominical) Letter, of the Equable year.

Cycle.			Dom. Lett.
Year i	Thoth 1	Feria 1	A
ii	— 1	— 2	G
iii	— 1	— 3	F
iv	— 1	— 4	E
v	— 1	— 5	D
vi	— 1	— 6	C
vii	— 1	— 7	B
Year viii = i	Thoth 1	Feria 1	A

It follows that, so long as a given number of years in the Æra Cyclica of the Tables is a multiple of *seven*, the hebdomadal character (the place in the order of feriæ of the *first day* of the equable year, of the *Thoth* of the year) of every eighth year will be the same as that of the first. As therefore each of our Julian Periods is a multiple of seven in the Æra Mundana and Æra Vulgaris perpetually; so is it at first in the Æra Cyclica: i. e. as long as the nominal sum of one of these Periods is the same in the Æra Cyclica as in

either of the other two. Accordingly it will be seen from the General Tables that the hebdomadal character of Thoth 1, in this æra, at the beginning of the first Period, A. M. 1 B. C. 4004 Ær. Cyc. 1, viz. the *Feria prima*, recurs at the beginning of every subsequent Period from the first to the fourth, A. M. 365 B. C. 3640 Æra Cyc. 365.

In the course of time however the first day of the equable year must fall on the first of January in the Julian, and in the Julian leap-year too; in which case, as we have already explained[p], two equable years will begin in one Julian year: one on Jan. 1, the other on Dec. 31. The nominal sum of annual equable time consequently will now become greater by unity than the accompanying sum of Julian: and the hebdomadal character of the first Thoth of the equable year at the beginning of the next Period will rise one number higher than it was before.

This case happens four times in the whole compass of the Æra Cyclica comprehended in the Tables; once at the ingress of Period v, Æra Cyclica 506; a second time at the ingress of Period xvii, Æra Cyclica 2047; a third time at the ingress of Period xxx, Æra Cyclica 3588; a fourth and last time, at the ingress of Period xli, Æra Cyc. 5017: the united effect of all being this, That the hebdomadal character of Thoth 1, in the equable æra, the recurring hebdomadal index of the æra at the beginning of the Period, which set out with being the Feria 1ª, ends with being the Feria 5ª.*

In the case of the Æra Cyclica, which is this proper

* The reader will perceive on reflection that in each of these cases the hebdomadal character or feria of origination, attached at first to the first of Thoth, when it ceases to be attached to the first of Thoth under the same circumstances as at first, begins to be attached to the next lowest term in the order of the equable notation; first to Epagomene 5, then to Epagomene 4, and so on, down to Epagomene 2; lower than which it does not descend in the complex of our Tables. Thus at the ingress of Period xli, Æra Cyc. 5017, Thoth 1 was the Feria 5ª, Epagomene 2 was the Feria 1ª. The Julian year was A. M. 5013 A. D. 1009. The Julian date of Thoth 1 (at midnight) was Dec. 28, of Epagomene 2 was Dec. 24. The Dom. Letter being A (division C Gregorian cycle) Dec. 28 was Thursday, Dec. 24 was Sunday.

p Supra, p. 57.

equable æra from first to last, this cycle of equable feriæ, this Solar Cycle of the equable year, as we have already explained, is noted in our Tables, in division E, perpetually, in the column expressly attached for that purpose to the Julian dates of the æra. The reader will perceive that this cycle enters our Tables along with the first day of the Cyclical Thoth, under its proper Julian date, on the Feria Prima of the first hebdomadal cycle; and that, beginning with this, it may be traced through every term in this cycle in its turn in cycles of seven perpetually to the end of the Tables: i. e. for 6007 equable years.

The proof which is thus supplied of the truth of the hebdomadal cycle of the Fasti is the most complete, and yet the most plain and obvious imaginable. It appeals to men's common sense, and to their personal experience and consciousness every where. When we come down with this Solar Cycle of the æra to our own times, we may judge of its truth from the matter of fact, and from the evidence of our own senses: and its truth at the present day being attested and confirmed by evidence so clear and infallible as that; let any one who doubts of its truth in time past trace it back, if he is so inclined, through this column of its proper feriæ, from the present day to the beginning of things, and say where it fails, where any hiatus or interruption is to be discovered in it. If no where, such a cycle and in such an æra must be as true at first as at last. It is impossible that it could begin with being false and end with being true; or end with being true and begin with being false.

The argument which we are thus proposing of the truth of the cycle in question may be more distinctly stated as follows.

Every equable year contains the same number of days and nights perpetually, viz. 365. Every equable year of the Fasti at least does so. Not one of these years enters our Tables from first to last, in which there are either more or less than 365 actual cycles of day and night. This being the case, any one must understand that every equable year of our Fasti has contained 365 hebdomadal feriæ, 52 weeks, and one feria over, perpetually: and forasmuch as there are 6007 of these years in our Tables from first to last, there are

6007 × 52 weeks, and 6007 feriæ over; which are equal to 858 weeks more, with one feria over remaining at the end of all.

If then the first of these 6007 years entered the Tables on the Feria Prima, the 6008th ought to enter the Tables on the Feria Secunda. It will be seen from the Tables accordingly that Æra Cyc. 6008 entered on Thoth 1, and on Thoth 1 at 18 hours, or at midnight, corresponding to April 30 at 18 hours, or May 1 at midnight, A.M. 6004 A.D. 2000: and the Dom. Lett. A. M. 6004 A. D. 2000 in the Gregorian Cycle, division C, being B A, May 1 at midnight must be the Feria Secunda. Thoth 1 then, in the last year of the Æra Cyclica which enters our Tables, enters them on the Feria Secunda. The column of feriæ, attached to those Thoths perpetually, shews this at once. But this is a mode of argument which would have proved that it must and would do so, without any assistance from that column, if it only set out at first, in the first year of all, on the Feria Prima. And conversely the fact, that the 6008th Cyclical Thoth of the æra was entering the Tables at this time on the Feria Secunda, should be a demonstrative proof that the first must have entered them on the Feria Prima.

The same result follows if we trace the succession of these Feriæ perpetually through the Æra of Nabonassar, instead of the Æra Cyclica; only that we must set out, in this case, from the Nabon. Mesore 9 Ær. Cyc. 0—1, and come down to the Nabon. Mesore 9 Ær. Cyc. 6007—6008 = Nab. 2748—49 proper. Now Mesore 9 Ær. Cyc. 0—1. being the Feria Prima, then for the same reason as before Mesore 9 Æra Cyc. 6007—6008 Nab. 2748—49 must be the Feria Secunda. Accordingly Nab. 2748, as the Tables shew, Mesore 9 is falling March 14 at midnight, A. M. 6004 A. D. 2000. And the Dom. Lett. in the Julian Cycle, division C, being C B, March 14 is the Feria Secunda. The first of Thoth Nab. 2749 April 10 at midnight must consequently be the Feria Prima; as the column of feriæ, attached to the Nabonassarian Thoths under their proper Julian dates and in their own æra from A. D. 225 downwards, shews it to be *.

* We reckon from Mesore 9 as the radix of the entire succession of feriæ in the Nabonassarian form of the equable æra, from the first to the

Section VIII.—*Solar Cycle of the Julian Year.*

The case is the same with the Solar Cycle of Chronology, the Solar Cycle of the Julian Year; the cycle which brings a given Julian date in a given year of the cycle of leap-year, from a given term in the order of feriæ, round to the same term in the same year of leap-year perpetually. The Julian year in itself is fixed and invariable. Its laws are immutable, its conditions never lose their prescription. And in the constant administration of such a year none of these can be overlooked or dispensed with; all must be attended to and all must be observed alike.

And yet, in whatsoever point of view it may be regarded, what is called the Julian year is after all only a certain cycle of days and nights: and, for this reason among others, none of its peculiar laws and conditions either is or can be so essential to it in every respect, so inseparable from its very being and continued existence, as the cycle of leap-year, or rather of the leap-day. It is this cycle, and this alone, which keeps and maintains it a cycle of days and nights of the same kind and of the same magnitude perpetually; and if there is but a cycle of this description in the administration of a particular form of the civil year, a cycle of regular use and application at stated intervals of time asunder; it is of no importance what the year itself may be called, or what the absolute measure of this cycle may be. The year in question in point of fact is Julian, regulated and adminis-

present day, for the reason explained at large, Fasti Catholici, i. 642. Diss. viii. ch. ii. sect. x. The original epoch of this succession and in this æra was Mesore 10 corresponding to April 25; and both to the feria prima. The epoch at present, and ever since B. C. 672 Æra Cyc. 3335, is Mesore 9 corresponding to April 24, and both to the feria prima too. What we have just pointed out of the hebdomadal character of Thoth 1 Nab. 2749, thus consequentially obtained from that of origination, is demonstrative of the fact of this change from Mesore 10 to Mesore 9, and therefore of the corresponding change from April 25 to April 24, without any change in the hebdomadal character or feria of either from the first. For had there been no change, then Mesore 10, not Mesore 9, Nab. 2748–49, must have been falling on the feria secunda; and therefore Thoth 1 Nab. 2749 on the feria septima. And this would be impossible, consistently with its Julian date *de facto* at that very time April 10 at midnight, A. M. 6004 A. D. 2000, Dom. Lett. C B.

tered on the proper Julian principle; and this cycle is its proper Julian cycle of leap-year. In the Roman correction of Cæsar it was appointed to be a cycle of four years; and in the modern Julian calendar it is still a cycle of four years: but the history of calendars brings cases to light in which the cycle of leap-year was a cycle of 52 years; and still more in which it was one of 120 years. And yet the calendars of which this distinction held good were Julian notwithstanding, as much as the Roman correction of Cæsar itself.

Now this being the case; in an annual cycle like this, which we call the Julian year, consisting in reality of 365 cycles of actual day and night at one time, and of 366 at another: two things are perpetually to be regarded over and above the general succession of day and night, and the accompanying succession of feriæ, which runs through every cycle or complex of days and nights and under whatsoever denomination alike; one, the place of a given noctidiurnal cycle and its accompanying feria in the succession or order of this annual cycle, the other the place of the annual cycle itself in the order of the cycle of leap-year: and the interval of time, which will bring round the same day and the same feria in the general succession of noctidiurnal cycles and hebdomadal feriæ to the same term or same place in this particular succession of both in the cycle which is called the Julian year, and this cycle or year itself to the same term or same place in the cycle of leap-year, (whether four years only, or more than four,) and which will do this perpetually, will be the Solar Cycle of the Julian year; the proper Cycle of that Julian year which has such a cycle of leap-year as this.

The first day in the proper Julian year, (i. e. in the Julian year of which the cycle of leap-year is a cycle of four years, according to the proper rule of the Roman correction of Julius Cæsar, and according to the proper modern rule,) being supposed to coincide with the Feria Prima in the hebdomadal cycle in the first year of the cycle of leap-year; the length of this year in the three first years of the cycle of leap-year being just the same as that of the equable year, this first day in the Julian year, setting out from the feria prima in the first year of the cycle of leap-year, will advance

one day in the order of feriæ in each of the first three years of the cycle, just as the first day of the equable year has been seen to do: and at the beginning of the fourth year, it will be found to be entering the hebdomadal cycle on the feria quarta. But this is the year in which the complex of noctidiurnal cycles, which we call the Julian year, consists of 366 such cycles instead of 365. At the beginning of the fifth year therefore instead of entering the hebdomadal cycle on the feria 5ª, as the first day of the equable year has been seen to do, it will be found entering it on the feria 6ª. And, if we trace the course and succession of this first term in the annual complex of noctidiurnal cycles in question in the hebdomadal cycle, and that of the complex itself in the cycle of leap-year, through successive cycles of both kinds; we shall find that it neither can nor will return to the same feria of the hebdomadal cycle from which it set out at first, and in the same year of the cycle of leap-year in which it set out, until the annual complex of noctidiurnal cycles has run through seven of these cycles of leap-years, which are the same thing as 28 repetitions of itself, and the noctidiurnal cycle in the general succession has run through 10 227 particular revolutions, and the hebdomadal cycle through 1461 cycles of feriæ, or noctidiurnal cycles in the order of seven at a time perpetually. But when all this has been done, the first term in the annual complex of noctidiurnal cycles in question, the first term in the cycle of feriæ, and the first term in the cycle of leap-year, will all meet again as before; and all will be in a state of preparation to begin and to run through the same cycle of change and restitution, both absolutely and relatively, and in the same length of time, as before.

The proper measure then of the Solar Cycle of the Julian year, (understood in this sense, and with a view to this restitution perpetually of a given term in the order of the days of the year to a given term in the order of feriæ, and of the year itself to a given term in the cycle of leap-year,) is 7×4, or 28; i. e. the hebdomadal cycle multiplied by the cycle of leap-year. Consequently the solar cycle of the Julian year is four times as long as that of the equable year, which was the hebdomadal cycle multiplied by unity

only. And as a general rule, (applicable to every conceivable form of this complex of noctidiurnal cycles which we call the Julian year, which has but a proper cycle of leap-year of its own,) whatsoever be the assumed cycle of feriæ in which it is required to trace the course and succession of a given term in the order of the days of the year, and whatsoever the cycle of leap-year supposed to be peculiar to this form of the Julian year itself; the proper Solar Cycle of such a form of the Julian year is the product of these two factors, the cycle of feriæ and the cycle of leap-year multiplied one by the other. Were the cycle of feriæ a cycle of 8, instead of one of 7, (as in the nundinal cycle of classical antiquity,) and the cycle of leap-year one of four; the solar cycle in that case would be one of 8×4, or 32 years. In the sexagesimal cycle of the Chinese, it is a cycle of 60×4, or 240 years. If the cycle of leap-year were a cycle of 120 years, instead of 4, (as in very many of the calendars of antiquity,) and the cycle of feriæ were the hebdomadal, or cycle of seven; the solar cycle in this case would be a cycle of 120×7 or 840 years. And such cycles must once have existed*.

It is an obvious inference from these premises that the Solar Cycle, in the proper chronological sense of the term, is nothing but the periodic restitution of a given Julian term, in a given year of the cycle of leap-year, from a given term in the order of feriæ, to the same term in the same order and in the same year of the cycle of leap-year, perpetually. It is of no importance to this cycle, what the given Julian term may be; or what the year of the cycle of leap-year; or what the particular feria in the hebdomadal cycle. The period of restitution is the same under all conditions and all circumstances of these kinds alike; and this period is the proper Solar Cycle of the Julian year under all cases of the kind alike. It is most natural to suppose it to be the first term in each of these successions, which is thus to set out from a

* The cycle existed, and of this length of 120 years, in all the cyclico-Julian calendars of antiquity: (see Fasti Catholici, i. 555. Diss. vii. ch. ii. sect. iv:) but the rule was not to intercalate one day only at the end of that time, but 30 days; which was the same thing (in all but the cycle of feriæ) as intercalating one day every four years, for 120 years in succession, according to the proper Julian rule.

state of coincidence, and thus to return to a state of coincidence, with the same in the rest perpetually: and in a constant succession of each, brought down in juxtaposition one with another, from such a common epoch or point of origination of all as the beginning of each for the first time, it would be little better than absurd to suppose it otherwise. But, as we have already observed[q], to find such a common epoch as this, and to bring down each in its proper succession from that, yet along with the rest; we must go back to the beginning of things. It never could be discovered or met with at any point of time short of the actual commencement of time itself.

SECTION IX.—*The Solar Cycle of Chronology inapplicable to the Natural year.*

Another inference from the above premises is That the Solar Cycle, defined and accepted in such terms and in such a sense as this, is not applicable to the natural year; or only in a modified form, and for a limited time at once. One and the same cycle is perpetually applicable to the Julian year; and as long as the Julian year continues the same with itself one such cycle only can be applicable to it perpetually. But the case is very different with the natural year; i. e. with that measure of time, distinct from every thing else of the same kind, yet entire and complete in itself, which alone is properly to be called the annual, or the measure of duration by the year. It is impossible that the same day in the natural year should constantly return to the same term in the order of feriæ, at stated and regular intervals of time asunder, as it must do in the Julian year. The order of feriæ being fixed and immutable, and the length of the natural year (the mean natural or tropical year) being fixed and immutable also; if this is less than that of the mean Julian year, a given day in this year can never return to a given feria, in the same length of time and under the same circumstances, as a given term in the mean or actual Julian year[r].

The mean natural year loses 11 m. 9 s. 36 th. of mean solar time on the mean Julian year, every year; and in 129 years it loses 24 hours: and it may even be assumed without

q Supra, Page 131.
r Cf. the Fasti Catholici, i. 496. Diss. vi. ch. iv. sect. xii.

any material error, that it does this according to a cyclical rule, every 112 years at one time, and every 140 at another. If therefore the first day in the Julian year, so called, was the first day in the natural, (which only is to be called the year,) at the beginning of one of these Periods; what must it be, in relation to the natural year, at the beginning of the next? The *first* day in the Julian must now be the *second* in the natural: and the *first* in the natural must now be the *last* in the Julian. And the order and place of each of these terms, though still the same as before in its proper succession, yet as referred to the other being thus changed; they cannot continue to preserve the same relation to any thing else, to which they were referrible in common before, like the hebdomadal cycle: particularly if that has continued all the while the same, without any reference to either. If the first term of the Julian succession called the Julian year was the first term of the hebdomadal cycle, at the beginning of one of these Periods, and if it continues to be the first term of that cycle at the end of it also; the first term of the natural cycle, which is properly to be called the year, might be the first term of the hebdomadal cycle also at the beginning of the same Period, but it cannot possibly continue to be so at the end: it must now be the last term in the same hebdomadal cycle; i. e. the feria septima.

In short it is not possible that the first day of the natural year should return to the same feria at the end of 28 years perpetually; while the order of feriæ itself remains invariable, and independent of every thing but the simple succession of day and night. It may do so in a limited sense; and for a limited time, which may be assumed at four cycles of the kind, or even at five. But the assumption must cease to be true, in any tolerable sense, at last. Were the case otherwise, the mean natural year must be absolutely the same with the mean Julian; and the standard of the one the same as that of the other. A given date in the former then, and a given date in the latter, can never occupy the same feria at stated and regular times, such as are meant by the Solar Cycle in the Julian year, perpetually; though they may be supposed to do so for a limited time. But the longer one of these measures of duration by noctidiurnal time in terms of

annual is compared with the other, and the longer they go on in conjunction in the same cycle of day and night, and in the same cycle of feriæ, each according to its proper law; the greater the disparity between them in terms of each of these common successions, the succession of day and night and the succession of feriæ, must become at last: of which we cannot have a clearer proof than this fact; viz. That the same day in the annual Julian cycle of this kind, which was the first in the corresponding natural annual cycle, and was occupying the same place in the order of feriæ as that, at the ingress of the first of our Periods, A. M. 1 B. C. 4004; was the 48th at the ingress of that which is now current, A. M. 5797 A. D. 1793, and will be the 49th at the ingress of the next, A. M. 5909 A. D. 1905.

It follows from the same premises that a given Julian term cannot express both the first day in the natural year, and the first day in that complex of noctidiurnal cycles which we call the Julian year, and the first or any other term in the order of feriæ, perpetually; or regularly at stated times. If it is to continue to represent the first term in the order of feriæ, at stated times, perpetually; it must some time or other cease to express the first day in the natural year any longer. If it is to continue to represent the latter; it must cease at last to represent the former. These things in short are perfectly incompatible; The *same* standard of the mean natural year; the *same* succession of mean vernal equinoxes, (which are properly the first day in the natural year perpetually,) both in the natural and the civil notation of that succession; the *same* Julian type of the natural year; the *same* order of feriæ, and yet the *same* Julian and natural notation of that order, perpetually. If they are to be rendered compatible, so long as there is no such thing in existence as the actual Julian year, to accompany the natural, and to supply it with its proper nomenclature, perpetually; one must give way to the other, and one must be accommodated to the other: and it is easy to see that, as the natural cannot be compelled to give way to the Julian, the Julian must be accommodated to the natural. In which case there is no alternative left, with a view to preserve the same relation between them perpetually, and to retain one and the same

uninterrupted notation of natural noctidiurnal, and natural annual, time in terms of Julian, except that of a succession of Julian Types of the natural year itself; one as exact a measure of it as another, and all alike amenable to the proper laws of the Julian calendar, (each in its turn, and as long as it continues in use,) both as regards the cycle of leap-year and as regards the solar cycle.

On this point however we have sufficiently explained ourselves elsewhere[s]. Suffice it to say that every condition of the Julian reckoning of time is assumed in our Tables as indispensable from the first, and is religiously observed from first to last; and yet our Julian Types, down to a certain point of time, without ever ceasing to be Julian, are constantly changing in appearance, and still are always remaining the same in reality as much as the natural year itself, which serves as a perpetual standard of reference for them. Under these circumstances, it is no longer surprising that the order of feriæ should always be the same in both, or rather that of both in the order of feriæ; and consequently that the solar cycle of both should always be the same.

Section X.—*On the Cycle of the Dominical Letter.*

The Solar Cycle is also called the Cycle of the Dominical, that is of the Sunday, Letter; and in our opinion, this mode of designating and denominating it is more proper than the other: for it has nothing to do, as we have seen, with the sun, but it is inseparably connected with the course and succession of feriæ, the first of which is the Feria Prima, the Dies Dominica, or Sunday. And yet it derives even this name from the use and application of the cycle, and not from the nature of the cycle itself.

Any given date in the Julian year, whether January 1, as most agreeable to the Julian rule at present, or March 1, in conformity to the original rule of Cæsar, or April 24, (which would be most in unison with the true cycle of annual Julian time from the first,) any one of these terms, we say, being fixed upon as the radix or epoch of the noctidiurnal in the annual and in the hebdomadal succession; it must fall on some feria in the hebdomadal cycle. And among the pos-

[s] Fasti Catholici, i. 452. Diss. vi. ch. iv.

sible forms of this incidence, let us suppose that to hold good first, which in a constant and parallel and simultaneous succession of this kind is most agreeable to the reason of things; viz. that the first term in the annual falls on the first term in the hebdomadal cycle: Jan. 1 for instance on the *feria prima*. If then we think proper, for convenience sake, to adopt as the symbol of this incidence the letter A; we may say, in this case, that A is the Dominical or Sunday letter: what we mean thereby being that January 1 is the Feria Prima. And in this case too, every one must see that A would be called the Sunday letter with the utmost propriety; because it points, in this case, at once to the first feria prima in the hebdomadal, in the order of the annual, cycle: and that too the very first day of the year itself.

When January 1 in the first year of the cycle of leap-year falls on the Feria Prima or Sunday in the next year it will fall on the Feria Secunda or Monday: and if we agree to adopt, for the same reason as before, as the sign of that incidence, the letter G; then we may say, as before, G is the Sunday letter: though G cannot be called by this name so properly in this case as A was in the former; because it does not point to the first feria prima in the annual cycle, but to the first feria secunda: though it does now point to the first day in the year as the feria secunda, as much as A before to the first day as the feria prima. And yet it points indirectly to the first feria prima in the annual cycle, in this case, too: for, if we know directly from it that the first feria secunda is the first of January, we know indirectly that the first feria prima is the seventh of January.

In like manner, in the third year of the cycle of leap-year the first of January will be the Feria Tertia or Tuesday; and the badge of this incidence being supposed to be F, F must now be called the Sunday letter: though it points directly not to the first feria prima in the order of the year, but to the first feria tertia. It still points however to the first day of the year in this relation to the first feria tertia; and it directs us by implication to the first feria prima and its place in the order of the year too: for if we know thereby that January 1 is the first feria tertia we know also that January 6 must be the first feria prima.

Proceeding in this manner, year by year, we get the following scheme of the Dominical or Sunday letter, from A to G.

Feria	Prima,	January	1,	Dominical	Letter	A
—	—	—	2,	—	—	B
—	—	—	3,	—	—	C
—	—	—	4,	—	—	D
—	—	—	5,	—	—	E
—	—	—	6,	—	—	F
—	—	—	7,	—	—	G

And, according as the first day of the year, January 1, falls on the different feriæ of the week respectively, beginning with the *second*, or Monday; both the Dominical Letter, and the first day in the year which falls on the feria prima or Sunday, may be summarily exhibited as follows:

January 1,	Mond.	Tuesd.	Wedn.	Thursd.	Frid.	Sat.	Sund.
Dom. Lett.	G	F	E	D	C	B	A
Feria Prima,	7	6	5	4	3	2	1

The place of January 1, in the order of feriæ, being thus known for every year of the cycle of leap-year; it is easy to deduce from it that of every other Julian term in the year, down to December 31: for all these depend upon that of January 1; and tables are easily constructed, to shew this at one view for every day in the year. Such tables are however not of very common occurrence in chronological works, and may not always be at hand when wanted; for which reason we have thought it necessary to incorporate one of this kind among the Supplementary Tables of our Fasti, viz. Table liii. And though this might seem a proper place to exhibit the scheme of the Dominical Letter also, through the different years of the cycle of 28 years, called the solar, we have not thought proper to do that; first, because we make use of no fixed and perpetual type of that scheme before a certain time; secondly, because the types which we do actually use, before and after that time, are exhibited all along in our Tables in division C, and may be seen, and examined, or consulted there, at any time.

We may conclude with observing that, in every type of this kind, in the leap-years of the cycle of 28, there is a double Dominical Letter, the first of which serves from Jan. 1 to

Feb. 29 in such years, inclusive, the second for the rest of the year, beginning with March 1. The mere statement of this fact, which is not peculiar to our Tables, is sufficient to prove that, according to the actual administration of the Julian calendar at present, and always in the use of chronology, its proper cycle of leap-year bears date not from Jan. 1, but from March 1. According to the actual rule of Cæsar, (borrowed from the old rule of the calendar, from the time of Numa downwards,) it bore date on the day after the bissex kalendas Martias, i. e. the day after Feb. 24 in the Roman style, on the vi kal. Martias repeated (Feb. 24 Roman repeated); on Feb. 25 in the modern style of the same things[t]. The first letter in leap-year, in this case, served down to Feb. 25 in the Roman calendar inclusive; the second for the rest of the year. Agreeably to the principles of our own Fasti, Julian annual time would be reckoned at first from April 25, at present from April 24: and therefore the proper bissextile day, in our system, at first would be April 24, and at present April 23, repeated.

CHAPTER IV.

On the Solar Cycle, and the Dominical Letter, of the Fasti.

SECTION I.—*Relation of the Cycle of* 28 *years to the decursus of true annual time in the Æra Mundana.*

It is agreeable to matter of fact, (and account for the fact as we may, it is a remarkable coincidence,) that the whole of the interval, from A. M. 1 B. C. 4004 to A. M. 4005 A. D. 1, distributes itself into a certain number of complete cycles of 28 years; so that A. M. 1 B. C. 4004 being assumed as the date of the first in the Æra Mundana and Æra Vulgaris, A. M. 4005 and A. D. 1 is that of the 144th: and the series of such cycles being continued from A. M. 4005 A. D. 1 to the end of the Tables; the date of the 215th is A. M. 5993 A. D. 1989: and consequently the number of such cycles in all,

[t] Cf. the Art de vérifier les dates, Preliminary Dissertation, § xv, Pag. xxvii, et seqq.; § xvii, Pag. xxix.

from A. M. 1 B. C. 4004 to A. M. 5993 A. D. 1989, is 214 exactly.

It follows from this fact that if the first year of mundane time, (annual time in connection with the existing system of things,) was A. M. 1 B. C. 4004; mundane time took its rise in the first year of one of these cycles of 28 years, which measure the course and succession of the noctidiurnal cycle, in terms of the hebdomadal and in terms of the annual one which is called the Julian year, perpetually. And this is another of the singular and hitherto overlooked coincidences, which a true scheme of chronology brings to light; and one among other proofs, thereby supplied, that in the Divine mind, and in the providential constitution and adjustment of time and of its several relations from the first, the Julian reckoning of time itself, in conformity to all its conditions, and to this among the rest, must have been contemplated from the first. It is no accidental coincidence, that B. C. 4004 was thus the first year of the cycle of 28; and it may be demonstrated that the necessity of this coincidence is both attested and authenticated by a very remarkable phenomenon, connected with the solar cycle itself, at this very day; to which the reader's attention, we hope, will be drawn by and by.

It follows however from this coincidence, that if B.C. 4004, at the distance of 143 cycles of 28 years complete from A.D.1, or at the distance of 214 complete from A. D. 1989, was not the very year of the Mosaic creation, and therefore the very first year of mundane time in connection with the present system of things; some year at least must have been so, which was either 28 years earlier, or 28 years later, than B. C. 4004; or some multiple of 28 years, before or after this date, whatsoever that might be. *Thus much* at least, we say, is indispensable to any *true* scheme of mundane time from the first; that, begin where it may, it must begin in the first year of the cycle of 28 years, traced perpetually back, either from A. D. 1989 or A. D. 1. This condition holds good of the scheme of our Fasti; and it will do so of any other which, like that, takes its origin in B. C. 4004: but it will not hold good of any other which does not begin 28 years earlier or 28 later, or some multiple of 28 years earlier or later, than

this date. And, if there would be objections of another kind, (and insuperable objections too,) to the setting back of the cardo mundi even 28 years beyond B. C. 4004, or to bringing it down even 28 years lower than that; then from this fact alone the inference would be inevitable, that the true A. M. 1 in terms of the Æra Vulgaris was B. C. 4004.

SECTION II.—*On the Solar Cycle of the Natural year, and the Period of the Hebdomadal Restitution in that.*

It will not fail to be perceived by our readers that as we bring down the succession of annual Julian time in our own Tables, by means of an uninterrupted series of Julian Types, each of which is 112 or 140 or 56 years in length; we necessarily bring it down in a perpetual series of cycles of 28 years also: four of which enter into the period of 112 years, five into that of 140, and two into that of 56. The succession of such cycles consequently in our Tables is never once interrupted from B. C. 4004 to A. D. 1989.

Now each of these cycles is the proper solar cycle (in the limited sense of the term) for the time being of the annual Julian cycle of the Fasti. The first day of each is the Julian date of the mean vernal equinox for the time being; i. e. the first day of the mean natural or tropical year, under its proper Julian denomination, for the time being also. The feria of this first day in each, in the first instance of any such incidence at all, (i. e. at the beginning or origination of this whole series of cycles itself) is the *feria prima*, or first day in the order of feriæ too. And though, in such a system of noctidiurnal, hebdomadal, and annual, in the sense of Julian, time as this of our Fasti, it could not continue to be the feria prima at the beginning of every fresh cycle of 28 years, as well as at that of the first; yet, it will be observed, that it returns to this feria prima at the beginning of the cycle at stated times perpetually, i. e. after the revolution of a certain number of these cycles, commensurate with the duration of seven Julian Types of the Fasti: and that, at the intermediate points of time, on whatsoever feria it falls at the beginning of one of these Types; it returns to this feria, under the same circumstances in all respects as at first, with every fresh cycle of 28 years, so long as the Type itself continues to be in use.

Now this constant recession of the head of the cycle of 28 years, (the proper solar cycle of the Julian Types of our Fasti,) on the feria of origination, (the feria from which it set out in the first year of mundane time itself,) and its constant return to it again, under the same circumstances as at first, both in the mean natural and in the mean or actual Julian reckoning of mundane time perpetually, constitutes what may be called the Hebdomadal Restitution (or as the Greek language would designate it, Ἀποκατάστασις) of such a system of annual time as this of the Fasti, in the sense both of natural and of Julian at once; as supposed to have begun in connection with noctidiurnal in the sense of hebdomadal in a certain way, and to have gone on in connection with it in the same way ever after. It is the period which restores the first day of the mean natural year, in the sense of the first day of the mean or actual Julian year also, or *vice versa*, to the same relation to the hebdomadal cycle, as at first; and reinstates it in the same place in the order of feriæ in that cycle, as at first. And it will be seen on inspection, both from our General Tables, and from the various particular Tables which we have had occasion to compile and to propose in our general work, in illustration of this very point among others, that the measure of this period, at first, was 32 cycles of 28 years, 896 mean natural or mean Julian years indifferently[u].

It will be seen too that this continues to be the measure of the period in question, so long as the alternation of the Julian Types of our Fasti goes on regularly, at one time with Types of 112 years, at another with Types of 140 such years, in length. But the interposition of two Types in two instances, (from the special reasons of the case,) 56 years only in length; and the necessity of varying the alternation of the Types themselves, so as best to compensate for the defect inherent in the period of 112 years, by the excess in that of 140 years, and *vice versa;* unavoidably interfere with the absolute measure of this period, (which we call that of the Hebdomadal Restitution of the Fasti,) in particular instances: and prevent its being uniformly the same in length from first to last. All that can be laid down concerning it with certainty, and all that can be predicated of it in every

[u] Cf. Fasti Catholici, i. 496. Diss. vi. ch. iv. sect. xii.

instance of the kind alike, is this; That from the beginning to the end of our Tables it is neither more nor less than the sum total of seven of our Julian Types or Julian Periods perpetually: each of which being a perfect measure of the cycle of 28 years, any number of them collectively is a perfect measure of it too.

Did our Julian periods consist perpetually of 128 years in length; this period would be a cycle of 128×7 or 896 years perpetually—containing as we have already observed 32 cycles of 28 years. For though 128 by itself is not a multiple of 28; yet 128×7 is. And indeed had this period of 128 been as completely a multiple of 28 as it is of 4, it approaches so nearly to the true length of the period of the anticipation of the mean natural year of our Fasti on the mean Julian, viz. 129 years; that none, it is manifest, could have been fixed on as the proper measure of the Julian Period and Julian Type of the Fasti so properly as that. But the circumstance just pointed out, its not being commensurable with the cycle of 28 years in particular periods, only in a succession of seven periods of its own kind at once at least, effectually disqualifies it as the proper period of our Julian Types; while it renders it so much the fitter when multiplied by seven, to be the proper period of their Hebdomadal Restitution.

It will be observed that, while the first term of the cycle of 28 years is thus retrograding perpetually, in this great Period of the Restitution, through the several feriæ in the hebdomadal cycle, the Dominical letter recedes or goes back with it also; but in the reversed order of the letters themselves: for the letters in the advancing order of the cycle of 28 in the hebdomadal cycle are read on perpetually from G to A, i. e. backwards; and in the order of recession, to which we are referring, they run on from A to G, that is, forwards: so that, beginning with C as the token or symbol of the first incidence of the kind, that of the first term in the first solar cycle of the first Julian period of the Fasti (April 25) on the first feria prima at midnight: they recede ever after in the order of C D E F G A B, by one letter with the ingress of every fresh Type and of its first proper solar cycle. And when this has been done *seven* times, (i. e. when our Types

have been changed *seven* times,) they are found to have come round again to the same order in which they set out at first; and consequently to be again in a condition to begin and to go through the same cycle, and under the same circumstances, both absolutely and relatively, as before.

But it is very important to take notice, (nor can it be too frequently urged on the attention of the reader,) that the hebdomadal cycle itself, and the order of feriæ in that cycle, all this time continue absolutely the same, absolutely fixed and invariable. Nothing is varying all this time, as concerns that cycle, except the particular cycles of day and night which both in the natural and in the Julian reckoning of such cycles perpetually, but under their proper Julian names as the representatives and exponents of the natural for the time being, are occupying at different times the different seats of the feriæ of this cycle. These seats are always occupied at a given time and always by numerically different cycles of day and night; which, in such a representation of annual natural and annual Julian time in conjunction with noctidiurnal and hebdomadal perpetually, as this which we exhibit in our Fasti, are the same numerically Julian and numerically natural cycles, *communis generis*, for the time being. And as the latter are always the same in themselves and in reference to their proper succession of both kinds; are always the same terms in the annual natural succession, referred to the noctidiurnal; so must the former be through the natural: always the same, if not in themselves, yet as referred to their prototypes; always the same Julian terms as the representatives and exponents of the same natural for the time being.

SECTION III.—*On the Cycle of Leap-year of the Solar Cycle of the Fasti.*

The cycle of leap-year as restricted to four years necessarily enters seven times into the cycle of 28. The inspection of the Tables will shew that this proportion of the cycle of leap-year of the Fasti to the cycle of 28 years is preserved inviolate from first to last; and that there is not one of our solar cycles, until we come down to A. D. 224 the last year

of the 151st, which has more or less than its proper number of the cycles of leap-year. And though this may appear to be contradicted by the fact that, as often as we introduce a fresh Type of annual Julian time in connection with annual natural, we introduce a fresh cycle of the Dominical letter also, and therefore appear to dispense with a leap-day; in reality what we have asserted is not inconsistent with this fact: and the truth is that not a single leap-day is dispensed with in our Fasti in its proper order of time, from first to last, unless we think proper to except one; viz. That which, according to the rule of the Fasti until then, would have been in course at the egress of Type xxxiv and the ingress of Type xxxv, A. D. 224 or 225.

But in this particular instance, the leap-day, which we should thus seem to omit in the proper Julian administration of the Fasti, would still be supplied by the actual administration of the actual Julian year at Rome in that very year. It is capable of demonstrative proof, (and, if God so permits, we ourselves hope to demonstrate in due time,) that though we should suppose there was no leap-day in the last year of the xxxivth Julian Type of our Tables, A. D. 224; there was nevertheless the usual leap-day in the actual Julian year at Rome U. C. 977=A. D. 224. And as there was one day's difference between actual Julian time at Rome and the Julian time of our Tables previously; this very distinction oetween the administration of our Fasti and that of the actual Julian calendar, at this moment of time, and nothing else, (under God and his superintending Providence) was the very reason why in this year, A. D. 224 U. C. 977 ex kalendis Martiis, or the next year, A. D. 225 U. C. 978 ex kalendis Januariis, the actual Julian correction of Cæsar, which had now been in use 269 years at Rome without ever coinciding permanently with the Julian year of chronology; the Julian Type of natural annual time brought down in our Tables from the beginning of things; and the Julian type of chronology (in other words the modern Julian calendar), carried back from the present day to any distance; coincided or met together in a state of equality and of identity, both absolutely and relatively; and coincided permanently: so

that from that time to the present day there has never been any difference between them, which has not been purely nominal, apparent, and accidental.

On this point however we have already explained ourselves in our general work, as far as was practicable without going expressly and circumstantially into the history of the Roman calendar[x]. Suffice it then to repeat that our solar cycle has never wanted its proper complement of leap-days, according to the proper law of each of our Julian Types, without which they would not be Julian at all, saving in this one instance, (if we choose so to consider it as such an instance,) of exception to the general rule of our Tables until then: in which nevertheless it was otherwise supplied*. As to the cases of apparent exception to this rule, which have been adverted to, the egress of one Type and the ingress of another, (cases which occur 49 times in our Tables in all,) there *is* a leap-day even in these cases, and a leap-day which is taken into account; but it belongs to the Type which is coming in, and not to that which is going out. There was a leap-day even at the end of the first three years of present mundane time, as we have shewn in the proper place[y]; though according to the proper Julian rule, brought down from that point of time to the present day, there should *then* have been none:

* The truth is indeed that we omit no leap-year in the proper year of our cycle even in this case of the Egress of Type xxxiv and the Ingress of Type xxxv; at least no more than under the same circumstances at the Egress and Ingress of any two similar Types before. But it so happened that at this time the Type which was just coming into our Tables, Type xxxv, to take the place of Type xxxiv just going out of them, was to all intents and purposes the same with the actual type of the Roman correction, just at the same point of time, ex kalendis Martiis A. D. 224 or ex kalendis Januariis A. D. 225. So that, under these circumstances, it was indifferent to the succession of our Julian along with our natural annual time from the first, whether it was taken up and carried on by the xxxvth Type of our Fasti in its proper order of time, or by the actual type of the Roman correction, such as it was in its 270th year, ex kalendis Martiis or ex kalendis Januariis, at the same point of time. This will more fully appear, if we are permitted hereafter to treat of this correction *in extenso*, along with the rest of the history of the Roman calendar from first to last.

[x] Cf. the Fasti Catholici, i. 525. Diss. vi. ch. v. sect. x.

[y] Fasti Catholici, ii. 35–58. Diss. ix. ch. ii.

and there was such a leap-day, A. D. 224, according to the actual Julian rule at that time, even though we should suppose that there was none at the same time in our Tables.

This case will serve both to explain the theory of what we are contending for in general, and to attest, authenticate, and illustrate the application of the theory in practice, by the matter of fact in a particular instance; because the very same thing which is thus seen to have been actually done, at the egress of Type xxxiv and the ingress of Type xxxv, virtually took place, under similar circumstances, as often as there was occasion it should do, before. The in-coming Type, A. D. 224, (in this instance, the actual Roman or Julian year, the actual correction of the Dictator Cæsar himself, from which we derive the modern Julian calendar itself,) had a leap-day; the going out Type had none. And so had it been, in every similar case of the succession of one Julian Type to another, before.

The change of the Dominical Letter, which ensues on such occasions also, proves nothing. It is merely declaratory of the effect which has taken place, that is, of what has been done: it is no explanation of the reason why it was done, or of the mode in which it was done. This Letter however is changed, not by introducing a fresh character, but by continuing one already in use: and that makes a very great difference.

Thus, in the instance referred to, the egress of Type xxxiv, and the ingress of Type xxxv. Properly speaking, this took place on the 1st of March A. D. 224; though, according to the positive rule of the Tables, we suppose it to have done so on the 1st of January A. D. 225. Now in the last year of Type xxxiv, dated from January 1, A. D. 224, the Dominical Letters are twofold, C B: of which C would be applicable ordinarily from Jan. 1 to Feb. 29, and B from March 1. But this is the moment of the ingress of Type xxxv; which according to the Julian rule of reckoning annual time from Jan. 1, and according to the positive rule of the Tables conformable to that, would require to be set back to Jan. 1, A. D. 224. Even as dated *de facto* then from March 1 A. D. 224, this coming in Type is virtually dated from Jan. 1 A. D. 224; in the *last* year of such a Type as its own, sup-

posed to have been going on previously, as much as in the *first* of one which was dated *de facto* from March 1 *.

Now, in the *last* year of the proper solar cycle of Type xxxv, as any one may see from the inspection of the Tables, the Dom. Lett. are D C; of which D would serve from Jan. 1 to Feb. 29, and C from March 1 for the rest of the year. C then is the proper Sunday letter of the first year of Type xxxv ex kalendis Martiis A. D. 224, not B; and yet the year before this, supposed to expire on the same day, had its proper 29th of February: so that though the symbol of the incidence of Julian dates on the hebdomadal feriæ was changed at this moment, with the egress of Type xxxiv and the ingress of Type xxxv, the succession of such feriæ under their proper Julian names and exponents was not changed, but went on just as before; and the leap-day in particular,

* The true explanation of this fact also is that, though we make use of a succession of Julian Types as the civil substitutes for the natural year, and each of these serves that purpose only for one of our Periods at a time, and each of them comes into actual use in that capacity at a different point of time, one later than another perpetually; yet we make use of no such Julian Type, in this relation to the natural year, and as its conventional substitute and representative for a certain length of time, the epoch of which from the moment when it comes into use must not be supposed to go back to the beginning of things; and to the very point of time at which the natural year (which this Julian Type is assumed to be measuring in its own order and its own time) itself took its rise. Every such Julian Type of the natural year, from the time when it begins to be the proper measure of the natural year, and as long as it is so, must be supposed, on that very account and from that very relation to it, to be the proper Julian Type of annual time, according to the proper Julian rule, from the first until then. This distinction is founded in the reason of things. It is illustrated and at the same time confirmed by the matter of fact in relation to the actual Julian year itself. In its proper order of time this actual Julian year was nothing more or less than one of the Julian Types of our Fasti. It became the actual Julian measure of the natural year brought down from the first at the ingress of Period xxxv: and from that moment its epoch went back, in that capacity and in that relation to the natural year itself, to the beginning of things. And because this Type has continued the actual Julian measure of the natural year ever since; its epoch is still *de facto* the beginning of things. Julian time, carried back from the present day to the beginning of things, is carried back in this form and in no other.

required at this period of the cycle according to the strict Julian rule, was taken into account, only according to the Julian rule of the Type which was coming in with its proper cycle of leap-year and its proper solar cycle: not of that which was going out with both. And the Type so coming in, it should be remembered, at this moment was the only true Julian antitype of the only true natural prototype of annual time along with noctidiurnal and hebdomadal, from the first until then, the natural year. The Julian Type going out was already an entire day at variance with this; and within an entire day was incapable of representing it any longer either in itself, or as the succession of noctidiurnal or of hebdomadal time in terms of annual.

SECTION IV.—*Technical administration of the Dominical Letter of the Fasti, and combination of the Gregorian with the Julian Cycle of that kind.*

With regard then to the actual administration of the Solar Cycle of the Julian Types of the Fasti, the reader will observe that two Types of this Cycle are incorporated in division C of the Tables perpetually; one of them attached to the succession of the Julian equinox, the other to that of the Gregorian: and he will also please to take notice that these are in reality all along the same, though apparently different; one shewing the feria of the Julian equinox perpetually, the other that of the Gregorian: which in a given instance, on comparison, will always be found to be the same.

These two types, it will be perceived, begin with being the same; the first Julian equinox of the Tables being also the first Gregorian: and at stated times they again become the same; viz. as often as the difference between the Julian and the Gregorian equinox, beginning with unity in the second Julian Type of the Tables, and going on increasing by unity with every fresh Type, has accumulated to *seven* or to some multiple of *seven*. But there is no real difference between them, all this time; no more while they are seeming to differ than when they are thus periodically seen to be the same: no more than between the Julian and the Gregorian cycles of the same kind at the present day. It should be distinctly

understood however that, down to A. D. 225 at least, the proper Julian Type of this cycle perpetually is that which is attached to the Julian equinox.

SECTION V.—*On the Solar Cycle of the Fasti, corresponding to the proper Solar Cycle of Chronology.*

A. D. 225, along with the xxxvth Julian Type of the Fasti, it will be observed that a new type of the cycle of the Dominical Letter enters the Tables also; and from that time forward accompanies the cycle of mean Julian equinoxes perpetually. *This* type is the *true* type of the cycle of this letter in the Solar Cycle of Chronology; differing from the actual cycle of that kind, as we shall see hereafter, only *per accidens;* i. e. the actual cycle of that kind bearing date in the 20th year of *this*, and *this* in the 10th year of the actual: but in all other respects (all essential respects at least) the two types being absolutely the same.

Now the reason of this is that, (as we have often had occasion to assert,) A. D. 225 *ex kalendis Januariis* is the true date of the time when the actual Julian year at Rome, as it had been transmitted till then from the correction of Cæsar itself through the administration which it experienced *de facto* at Rome; when the Julian year, such as it exists and is administered at present, (or was so down to the date of the Gregorian correction,) and consequently the proleptical or chronological year of this kind, such as chronology must be supposed to carry back, for its particular purposes, from the present day; and lastly, when the Julian Types of our Fasti also, (the true Julian antitypes of the true natural prototype of annual time perpetually until then,) coincided one with the other, in a state of absolute identity, as they had never coincided until then: and not only coincided in that state for the first time then, but ever after continued to coincide; began to proceed at that time in a state of identity and a state of conjunction, which has never since been interrupted.

The actual Julian correction then of Cæsar, that is the actual Julian year, and the xxxvth Type of our Fasti, both entered our Tables together, either on the Kalends of March =March 1 U. C. 977=A. D. 224, or on the Kalends of

January = Jan. 1 U. C. 978 = A. D. 225, and each in a state of identity with and equality to the other. At this moment then the Julian succession of our Fasti was taken up by the actual Julian year: and that being the case, the proper Julian Type of that succession, which entered with it at the same moment, the xxxvth Julian Type of the Fasti, from this time forward must continue the same with it. Having entered the Tables in a state of identity and agreement with the actual Julian year; it must continue in the Tables in a state of identity and agreement with this actual Julian year, so long as that continues the same with itself; or from this time forward must vary from it only in the same way, and to the same extent, in which and for which the actual Gregorian year itself at present may vary, and does vary, in appearance, from the actual Julian; without being really different from it *.

Now a fixed and invariable Julian Type of annual time must have a fixed and invariable Solar Cycle; and a fixed solar cycle must have a fixed cycle of the Dominical Letter. The cycle which enters the Tables A. D. 225 along with the xxxvth Julian Type is *this* fixed cycle; and as we have already observed, in every thing but the epoch of the cycle, and in the consequent relation of its terms to the different years of a common cycle, it is altogether the same with the Dominical-letter cycle of the solar cycle of chronology. It is consequently the proper *Julian* cycle of the Sunday letter, peculiar to our Tables. It began to accompany the Julian

* The substance of what is here asserted is that A. D. 225, at the ingress of Period xxxv, the Julian Type of our Fasti becomes fixed in the form of the actual Julian year. Our proper Julian Type from this time forward consequently is the actual Julian year. The Types therefore later than Period xxxv, and different from that of Period xxxv, which carry on the succession in the same manner as before from this time forward, in comparison of this of Period xxxv, are Gregorian properly so called in comparison of Julian properly so called too. They must differ from this henceforward only as the actual Gregorian does from the actual Julian, both being supposed to have begun together, and to go on perpetually in conjunction. Our Julian Types indeed from the first have been virtually Gregorian too: but as there was no actual Julian Type to which they were constantly referrible before A. D. 225, they become actually Gregorian first in A. D. 225.

equinox, in the natural succession of annual time, A.D. 225: and it is still accompanying it in the same succession. It is the cycle in use at present, wheresoever the Julian year itself is still in use; the cycle of *old style*, properly so called, in contradistinction to that of *new:* and it is the cycle to which we must reduce all Julian dates, from A.D. 225 down to the present day, whensoever there is occasion to do so; or from the present day up to A.D. 225, though not beyond that date.

SECTION VI.—*On the proper Gregorian Cycle of the Sunday Letter of the Fasti.*

But the reader will doubtless observe also that, when the proper Julian Type enters the Tables, A.D. 225, a new Gregorian Type enters along with it also: and that, by virtue of a remarkable coincidence, the Julian Type at this moment and this Gregorian one are absolutely the same. The same term, March 21, is common to both. It is the first day of the year, both the natural and the civil, in both; and it is the same day of the week in both.

The reason of this too is that A.D. 225, just at the time when the Julian year itself was entering our Tables, the Julian equinox, brought down from the first, according to one and the same law of succession, in a state of equality to and of identity with the natural, was just beginning to fall on March 21 at midnight; and March 21 at midnight being the fixed Gregorian date of the natural vernal equinox, this coincidence (as every one must allow) was competent to define and designate this same year, A.D. 225, if not as *actually*, yet as *virtually*, the proper epoch of the Gregorian correction of the Julian year itself. There can be no doubt at least that the same reasons which induced the Roman pontiff in A.D. 1582 to raise the Julian date of the vernal equinox for the time being 10 days *per saltum*, viz. from March 11 to March 21, would have induced him in A.D. 225, with a view to the very same end and purpose, to take the Julian date of the vernal equinox for the time being then too, under its actual Julian denomination of March 21, and to constitute it without any change at all, the perpetual date of the same

natural phenomenon in the Gregorian reckoning, as opposed to the Julian, ever after.

We say then that A. D. 225, the date of the ingress of the xxxvth Julian Type of the Fasti, and the date of the coincidence of the proper Julian Type of the Fasti, in its proper order of time, with the actual Julian year of the Dictator Cæsar, is virtually also the date of the Gregorian correction of that very year, which was actually made 1357 years later: and we say too, that the coincidence thus brought to light, and thus seen to hold good, viz. that the Julian Types of the Fasti, (and through them the natural year,) the Julian year of the dictator Cæsar, and the Gregorian correction of that year, were all meeting at par in this year, A. D. 225, and were coinciding on one day of this year, the date of the natural vernal equinox, (the same day in the Julian or Gregorian notation of that natural phenomenon,) March 21, on the same hebdomadal feria, the *feria secunda*, at the same hour of the day, the hour of midnight, in the same year of the cycle of leap-year, and in the same year of the cycle of 28 years; is as remarkable as any thing of the kind which has yet been pointed out; and one which no right-minded and right-thinking person can have submitted to his apprehension, without both perceiving and acknowledging in it the *finger* of Providence.

It follows that, both at the beginning of the xxxvth Type of the Fasti, and for the whole of the decursus of that Type, there would be no difference between the Julian cycle of the Dominical Letter, and this proleptical Gregorian one. It follows also that, even at the end of that Type, when a new Gregorian cycle enters the Tables, while the Julian one remains the same; though a difference between them begins to appear, it is only in appearance: it is merely that which exists at present, and always has done, between the Gregorian and the Julian administration of the same thing. A fixed Type of the Julian year entering the Tables A. D. 225, in the form of the actual Julian year itself, and successive variable Types of the same year continuing to enter the Tables also after A. D. 225, as much as before; it is manifest that both the proper Julian reckoning of noctidiurnal and

hebdomadal time in terms of annual, and the Gregorian too, in contradistinction to that, are combined in our Tables from this time forward, and proceed together *pari passu* from A.D. 225 to the end: each of them consequently requiring its proper solar cycle, and cycle of the Dominical Letter, and each of them provided with both accordingly; the Julian in the cycle attached to the succession of Julian equinoxes from A. D. 225 perpetually, the Gregorian in the cycle attached to the Gregorian: the former fixed and invariable in itself, but attached to a constantly varying Julian term, the latter varying perpetually in itself, yet always attached to the same Julian, in the sense of Gregorian, term.

SECTION VII.—*On the proper Gregorian Cycle of the Dominical Letter; and on its equation to that of the Fasti both at first and ever since.*

The Gregorian cycle of the Sunday letter may thus be assumed to have entered our Tables, A. D. 225; yet the proper Gregorian cycle of the same kind, the actual cycle, the cycle in use at present along with the actual Gregorian year itself, must enter our Tables in its proper order of time too: and the observable circumstance at that time is, That the actual or historical cycle of the Gregorian Sunday letter enters our Tables at last in a state of absolute identity with the proleptical cycle of the same kind brought down until then from A. D. 225.

The actual date of the Gregorian correction was the 42nd year of the xlvth Julian Type of the Fasti, A. M. 5586 A. D. 1582. The style of the calendar, previously current, was of course what is now called *old style;* i. e. the proper Julian style from A. D. 225 until then. The Sunday letter of the 42nd year of the xlvth Type, in the Julian style, was G; i. e. A. D. 1582 the Sunday letter was G, and Oct. 5 was the feria 6^a or Friday. By virtue of the correction of the calendar which took place this year, the style of Oct. 5 became that of Oct. 15; but the feria remained the same: and consequently Oct. 15 was the feria 6^a after the correction, as much as Oct. 5 before it. Now when Oct. 5 is the feria 6^a, Jan. 1 must have been the feria 2^a, and the Dom. Letter consequently must have been G; but if Oct. 15 is the feria 6^a, Jan. 1 must have

been the feria 6ª *: and when that is the case, the Dom. Letter is C.

The correction of the calendar then made at this time, and made in this way, by changing the style of the feria 6ª in terms of the calendar from Oct. 5 to Oct. 15, virtually changed the Dom. Letter of the year from G to C. Now if we turn to the 42nd year of our xlvth Type, A. D. 1582, we shall see that, according to the Gregorian cycle of the letter in that Type and that year, the Dom. Letter was C, as it was: so that the effect of the correction was merely to assimilate the Julian style of the cycle, previously in use, to the Gregorian style of our Fasti brought down regularly from A. D. 225 until then. If the actual historical Gregorian cycle was thus merged in the Gregorian one of the Fasti at the very moment when it came into existence; this is demonstrative proof of the truth of this latter cycle at that particular point of time: and its truth at that moment is, or ought to be, a sufficient voucher for its truth from the first.

SECTION VIII.—*On the combination of two Types or forms of the same Gregorian Cycle of the Dominical Letter, from this time forward; and on the manner in which they are discriminated asunder.*

From this time forward then the proper Gregorian cycle of the Sunday letter enters the Tables along with our own; and both are thenceforward represented side by side, in two parallel Types, one of which is the Gregorian cycle of the Fasti, marked by the number 1, the other is the proper Gregorian cycle, marked by the number 2. It is easy therefore to compare them together perpetually; and it is evident, from this comparison, that all the time for which they go on together they never differ from each other, except *per accidens*. Each requires to be corrected at a stated time, and each is corrected at the proper time; and the mode of ad-

* There are 273 days, or 39 cycles of seven days, from Jan. 1 to Oct. 1, in the common years of the cycle of leap-year; so that Oct. 1 in such years always falls on the same feria of the hebdomadal cycle as Jan. 1. Hence if Oct. 5 is the feria 6ª, and therefore Oct. 1 the feria 2ª, Jan. 1 must have been the feria 2ª: if Oct. 15 is the feria 6ª, and therefore Oct. 1 the feria 6ª, Jan. 1 must have been the feria 6ª too.

ministering the correction is absolutely the same in each: but the times of the correction respectively differ. The Gregorian correction is administered to the proper cycle, according to the positive Gregorian rule, thrice in 400 years; and in the secular years A. D. 1700, A. D. 1800, and A. D. 1900, respectively. The cycle of the Fasti is corrected according to the same law after A. D. 1582 as before, at the ingress of successive periods; and these ingresses do not happen to coincide with any of those secular years, though they are not far removed from them in each instance. For a time then the Gregorian cycle seems to differ from that of the Fasti; but the difference is only apparent and only temporary: always disappearing as soon as both cycles have received the proper correction. The relation between them, while this difference lasts, is only like that of the Julian to the Gregorian, or *vice versa*, at all times. If the cycle of the Fasti is corrected before the Gregorian, then the Gregorian *pro tempore* becomes Julian, in relation to that of the Fasti; if the Gregorian correction anticipates that of the Fasti, the contrary is the case. At present, both cycles are the same, and have been so ever since A.D. 1800; and must continue so down to A. D. 1900 at least *.

* It requires no argument to prove that the Gregorian reckoning of time, in all its measures, noctidiurnal, hebdomadal, and annual, is only a modification of the Julian, and differs from the Julian only *per accidens*. The origin of the Gregorian correction itself is decisive of this; for, as every one must know, the Gregorian correction was directly derived from the Julian calendar.

It cannot however be denied that there is apparently a difference between them, which came into being along with the Gregorian modification of the Julian reckoning itself, and has gone on increasing in the same way ever since, and must do so, as long as both modes of reckoning continue to be used together. It cannot be denied that there was an original difference of styles, as it is called, amounting to *ten* days; and that this has now accumulated to *twelve*, and in the course of time will amount to *thirteen*, and so on: or, what comes to the same thing, that one and the same Gregorian term March 21 at first agreed to the Julian March 11, and now does so to the Julian March 9, and by and by will do so to the Julian March 8; and so forth perpetually.

It is not easy for those, who are accustomed to judge of the relations of things by their nominal or external characteristics merely, (which is the case with the common people every where,) to persuade themselves that

SECTION IX.—*Verification of the Solar Cycle and Dominical Letter of the Fasti by a simple perpetual test.*

We have thus brought down the proper Solar Cycle of the Fasti, and the proper cycle of the Dominical Letter, (both comprehended under the general name of the proper Hebdomadal Cycle of the Fasti,) from A. M. 1 B. C. 4004, to the present day; and we have seen each of them, without any management, without any violence, but merely as the natural spontaneous consequence of the administration of each according to one and the same law from the first, passing at the proper time first into the actual Julian, and secondly into the actual Gregorian, of the same kind.

It appears to us that, for the conviction of a candid and unprejudiced mind, no further proof of the absolute truth of both these cycles from the first, and of the fitness or necessity of that rule of administration, which has been applied all along to each, can be required, beyond the mere knowledge of such a fact as this. If however still more proof of the

this distinction of styles after all is only a distinction of names; and that the 9th of March in the one is really the same thing as March 21st in the other. The ultimate source however of all the confusion and all the difficulty, which the common people appear to have laboured under every where from the first in comprehending the distinction of styles, must be traced to the use of a common nomenclature for the names of the months in both. It is not easy for the common people to comprehend how or why March 9 should be the same as March 21st, both being days in the same month of March alike. All ambiguity however would have been removed, and all confusion and misapprehension prevented, if the same authority which changed the style on the Continent in A. D. 1582, or in this country in A. D. 1752, had changed the names of the months also: though whether this would not have occasioned greater inconvenience than what it aimed at removing, and would not have been liable to many serious objections in other respects, is another question.

No educated person requires to be convinced that the two styles are after all the same. If sensible proof of their identity is necessary, it may be had at all times, in the dates of the same solar, or lunar, or sidereal phenomena, referred to each; in the noctidiurnal and hebdomadal cycle, which run on the same in each: and in the usage and style of such countries as still retain the Julian calendar, compared with that of those which reckon by the Gregorian. An Englishman for instance has only to go into Russia, to have ocular demonstration that the two styles, though nominally different, are in reality the same.

same kind, and a still plainer or stronger demonstration of the same thing, should yet be desirable for the satisfaction of such persons as labour under old and inveterate prejudices on this subject; it may be furnished by the following appeal to a simple, but effectual, and withal perpetual, test.

It must be evident to any one's common sense That as there are only seven feriæ in the cycle of the week, and only seven Dominical letters; there are but seven modes of expressing all the possible forms of the incidence of the first (or any other given) day of the year, by means of these letters at least, on the different feriæ of the week: one viz. for each feria of the week. And as the first day of the year, (if that be assumed,) must fall on some one of these feriæ every year; and if it begins with falling on the first, it must go on and fall on each of the rest in its turn, at the rate of one term in advance every year in the common years of the cycle of leap-year, and at the rate of two in the leap-year: it is evident also that the *literal* test of the truth of the solar cycle, as a constant index of this constant advance of the head of the year among the feriæ of the week, for any length of time either forwards or backwards, is simply the constant recurrence of these seven letters, A B C D E F G, in the same order, as read either backwards or forwards; backwards, beginning with G, if we are tracing the course of the cycle in its natural order or forwards perpetually: forwards, beginning with A, if we are tracing the cycle itself contrary to its actual order, backwards. If the characters, which compose the cycle, can be read on either way without interruption perpetually, one for every common year of the cycle of leap-year, and two for every leap-year; then they represent truly the actual progress, the actual advancement, or the contrary motion and change of place, of the first day of the year in and among the feriæ of the week; either forwards or backwards, either downwards or upwards, perpetually.

Let this *literal* test then be applied to the Solar Cycle of the Fasti; beginning with any year of which the Sunday letter, even in the Fasti, is known from our personal experience and observation to have been the actual or true: as, for example, A.D. 1848 or 1849, the last year of cycle 209 or the first of cycle 210; the Dominical letter of which,

according to the Fasti, whether the Julian D C or B, or the Gregorian B A or G, it cannot be doubted is agreeable to the truth. And setting out from this year let the reader first of all trace the Gregorian cycle, numbered 2, upwards from A. D. 1848 to A. D. 1582; reading the characters A B C D E F G, as he proceeds, in the order of the alphabet perpetually; and let him note in particular too, as he proceeds, the secular years A. D. 1800 and 1700; and attend to this circumstance of distinction between them and the rest, that though leap-years in the order of the cycle of leap-year they have only *one* letter in the cycle of the Dominical letter, while every other leap-year has two: the reason of which he will of course comprehend to be, because these leap-years happen to be the dates of the proper Gregorian correction of the cycle of the letter itself.

Now A. D. 1582 is the known date of the Gregorian correction; and the order of the Sunday letter, in No. 2, from A. D. 1582 to A. D. 1848, whether forwards or backwards, is the actual matter of fact or historical order of that letter, in the actual Gregorian administration of the cycle from A. D. 1582 to A. D. 1848. Of this fact there cannot be the shadow of a doubt. If so, and the literal test of the actual, that is, the true, administration of this cycle in the actual Gregorian calendar is this, That read on, either backwards or forwards, the characters are read on without interruption, (and that too notwithstanding the omission of *one* of the letters in the case of two years in particular, which must otherwise have had *two*); let the reader next apply the same test to the Gregorian cycle numbered 1, from A. D. 1848 to A. D. 1582 also: and let him say whether the least difference is discoverable in the application of the test to this second case, compared with that which was made of it to the former: i. e. whether the letters in this case too do not run on in the order of the alphabet perpetually, one for every common year, and two for every leap-year; except in two or three such instances of exception, as before. For, if they do, then the cycle of the Sunday letter is represented as truly by No. 1 as by No. 2; though the latter is the proper Gregorian cycle of the kind, and the former is that [illegible]e Fasti.

And having thus satisfied himself that t[illegible]rian cycle

of the Sunday letter, according to the Fasti, from A. D. 1848 to A. D. 1582, is and must be agreeable to the truth; let the reader proceed to trace it, in the same manner, from A. D. 1582 to A. D. 225: and let him ask himself whether the application of the test in this part of the process is any thing different from what it was in the former; whether the letters do not still run on and recur in the same way perpetually, one for every common year, two for every leap-year, except in the years of the correction of the cycle itself: and if they do, and the literal applicability of the test is as unquestionable of this part of the process as of the former, let him answer the question, if he considers it necessary, whether one and the same administration of the same thing can be just and true perpetually, from A. D. 1848 to A. D. 1582, yet false and in error from A. D. 1582 to A. D. 225?

And having thus convinced himself of the accuracy of the cycle from A. D. 1848 to A. D. 225; let him at this moment pass from the column of the Gregorian equinox to that of the Julian, at the egress of Type xxxiv; and trace the cycle of the letters on that side of the Tables perpetually, from A. D. 225 to B. C. 4004, if he has patience to follow it so far: and say whether they begin or continue from this point too to be read on in any manner different from before. For if not; we put it to his common sense whether one and the same system of administration in a case like this can be absolutely true, absolutely consistent with fact, and absolutely to be depended on, from A. D. 1848 to A. D. 225; yet become quite a different thing as soon as it gets beyond that point, and the more so, the further it recedes from it, up to B. C. 4004, continuing all the while the same with itself?

This is a plain and simple way of stating the case, on this question. Every one may comprehend it; and every one may pronounce upon it. Yet must it not be supposed that for the truth of our hebdomadal cycle, from B. C. 4004 to A. D. 225, we rely on this argument only, simple and obvious and convincing as it is. On the contrary, there are a great variety of proofs of its truth, of a totally different kind, supplied by the course and succession of the cycle itself, whensoever it comes to be confronted with matter of fact; or subjected to the only absolute test and criterion of truth,

in a case like this, *ab extra*, viz. contemporary testimony: so that, on the whole, we do not hesitate to say that as no part of our Tables has been more circumstantially authenticated, and more completely verified, so none ought to be considered more entirely placed beyond doubt and exception of any kind, than the Hebdomadal Cycle and the Sunday letter.

CHAPTER V.

On the Concurrents and Regulars of former times; and on the proof thereby supplied of the true Solar Cycle of annual mundane time.

Section I.—*Reasons for treating of this system, though obsolete at present.*

The final end of the cycle of the Dominical letters, in constant connection with the cycle of 28 years, is without any trouble but that of the inspection of a proper table to find out the day of the week, on which any day of the month in the Julian calendar, from Jan. 1 to Dec. 31, has fallen or will fall in a given year of the cycle of 28. But before the introduction of these letters into use, men were obliged to have recourse to other contrivances, in order to attain the same end, though not in the same way.

Among these the most famous and the most general in former times was the system of Concurrents and Regulars; of which we propose to give some account, before we take our leave of the present subject. The system itself, having long been superseded by the use of the Dominical letters, must be considered at present as obsolete; yet a knowledge of it is necessary even at this day, in order to understand the technical details of the reckoning of time in books of the Gothic period, or mediæval antiquity: and we fully concur in the observation of Scaliger that, although the practical application of this ancient system in any way is no longer required, the theory and praxis of the system, for various reasons, should be kept in mind.

We know not indeed whether the system is not deserving of study on its own account. Many chronologers of modern

times have expressed their approbation or admiration of it, as combining much ingenuity in its conception, with great simplicity in its details and application[a]. And though every thing, which this system proposed to effect through its double machinery of Concurrents and Regulars, is effected by the Dominical cycle through the single instrumentality of the Sunday letter; yet this latter requires a table, and a complicated table too, which may not be always at hand: the scheme of Concurrents and Regulars might easily be carried in the head, and be always ready for use.

But the principal utility of this seemingly antiquated system is one which directly concerns the details and administration, as well as the principles, of our own scheme of time; and therefore renders it an object of interest and a matter of importance to us. It brings to light a remarkable fact to which we have already adverted[b]; viz. That the division of annual mundane time by the cycle of 28 years is a constitution of the Author of Nature; That true annual mundane time always has proceeded, and is still proceeding, in such cycles: and That these cycles themselves never have been different, nor are any thing different at present, from those of our Fasti. If this ancient and apparently obsolete system is calculated to bring such a fact as this to light, and to place it in a striking point of view; this is a sufficient reason why we should beg leave to bring it again prominently into notice, and to give as particular an account of it as may be necessary, before we conclude this part of our Introduction. The first thing to be done is to explain the terms themselves.

SECTION II.—*On the meaning of the terms Concurrents and Regulars.*

Three hundred and sixty-four days in succession, $=52\times7$, or 52 weeks, exactly: $365=52\times7+1$: $366=52\times7+2$. It follows that, at the end of every Julian year of 365 days in length, there will be an excess of *one* day over and above the last complete week, (i. e. the 52d hebdomadal cycle,) which

[a] See, in particular, the Lectures of the late Peer of France, Daunou, tome iii. p. 339 &c. Leç. x.

[b] Supra, p. 149.

has entered into such a year; and at the end of every such year of 366 days, there will be an excess of *two* days.

Let us be permitted to call this excess of the annual Julian cycle over the hebdomadal, as entering into it perpetually, the hebdomadal epact. This *hebdomadal epact,* so defined and so understood, will be what is meant by the Concurrent. The Concurrent is the excess of the annual Julian cycle over the hebdomadal in the cycle of 28 years perpetually; which, beginning with 0 or zero in the first year, is 1 in the second year, 2 in the third, 3 in the fourth, and (if the fourth year is leap-year) 5 in the fifth; and so on—until it amounts to 7, the measure of one complete hebdomadal cycle: in which case it casts off 7, and begins and proceeds as if from 0 or zero again, as before.

The learned authors of the "Art de vérifier les dates" appear to have been of opinion that the Concurrents were so called because they *concurred* with the *solar cycle,* or followed the course of the sun[d]; which is much the same thing as supposing that they concurred with themselves, or followed themselves: for the solar cycle itself, as we shall see by and by, is nothing but the cycle of Concurrents in question. In our opinion, the true reason and true explanation of the name is, That these Concurrents *concurred* with the Regulars for a common end and effect; that one *concurred* with the other, i. e. helped the other, to do something which neither could do without the other; viz. determine the feriæ of the days of the month perpetually.

As to the word Regular, or Regulars (*Regulares,* sc. *numeri*), it is no doubt derived from the Latin Regula, a rule or direction. But to understand the reason of this denomination, we must first exhibit the scheme of the Concurrents.

The sum of the hebdomadal epact defined as above, in every complete solar cycle of 28 mean or actual Julian years, is 28+7, i. e. 35 days=5 weeks exactly. Consequently, if there is no such epact at the beginning of the cycle (i. e. if the epact sets out from 0 or zero) there will be none at the end; the epact will return to 0 or zero again, at the end of the cycle: that is, the head of the cycle (the first, or any other day in the Julian year, on which it is assumed to have

[d] Preliminary Diss. P. xxx. § xviii.

set out) will be found to have returned to the same feria in the hebdomadal cycle at the end of 28 years, from which it set out at the beginning.

Assuming then merely, as the proper type of this cycle of 28 years, that which first enters our Tables A.D. 225, in the *second* year of the Julian cycle of leap-year, on Jan. 1 the *feria septima* at midnight; we may draw out the scheme of Concurrents, explained as above, for one such cycle of 28 years complete, in the following manner:

Scheme of Hebdomadal Epacts, or Concurrents, in the proper Julian Solar Cycle of the Fasti.

Year.	A.D.	Dom. Letter.		Feria.	Concurrent or Hebdomadal Epact.
i	225	B	January 1	7	0
ii	26	A		1	1
iii	27	G		2	2
iv	*228	FE		*3	*3
v	29	D		5	5
vi	30	C		6	6
vii	31	B		7	7
viii	*232	AG		*1	*1
ix	33	F		3	3
x	34	E		4	4
xi	35	D		5	5
xii	*236	CB		*6	*6
xiii	37	A		1	1
xiv	38	G		2	2
xv	39	F		3	3
xvi	*240	ED		*4	*4
xvii	41	C		6	6
xviii	42	B		7	7
xix	43	A		1	1
xx	*244	GF		*2	*2
xxi	45	E		4	4
xxii	46	D		5	5
xxiii	47	C		6	6
xxiv	*248	BA		*7	*7
xxv	49	G		2	2
xxvi	50	F		3	3
xxvii	51	E		4	4
xxviii	*252	DC		*5	*5

SECTION III.—*Observations on the above scheme.*

We have added the Dominical letters all through the different years of this cycle; yet it must be evident from the inspection of the scheme itself that, with such a scheme as this, for any such use and purpose as that of indicating the proper feria of January 1, in each of the years of the cycle of

28, the Dominical letters are not wanted. The Concurrents do it without their assistance. Consequently, in such a scheme as this, the Dominical letters and the Concurrents are the same thing; only under a different name.

For does the Dominical letter B, in the first year of the scheme, intimate that the first of January in that year is the feria 7a? The succession of Concurrents, as setting out in that year from 0 or zero, intimates the same thing too. Does the letter A in the second year imply that the first of January is the *feria prima?* The Concurrent of that year, unity, implies the same. Do the characters G F, in the *twentieth* year, indicate that January 1 is the *feria secunda,* or Monday? The Concurrent of the year, 2, indicates just the same thing. It is evident therefore, that in such a scheme as this the Concurrents and the Dominical letters, *mutatis mutandis,* are the same thing. The cycle of the one is the cycle of the other: the meaning of the one is the meaning of the other. Both point out the feria of January 1 in each year of the 28 in its order; and each points it out alike.

It follows that, with such a scheme as this, in order to know the feria of January 1, in any year of the cycle, nothing could be necessary except to know the Concurrent of that particular year: and the feria of January 1 being thus known, and in this way, from the Concurrent alone; the feria of the first day of every month after January would be easily to be known, by adding to the feria of January 1, so determined beforehand, (i. e. in fact adding to the Concurrent,) a constant quantity for every successive month. For on whatsoever feria the first of January falls the first of February will fall *three* feriæ later; the first of March in the common years of the cycle of leap-year will fall *three* feriæ later too, and in the leap-year of the cycle *four:* the first of April will fall *six* feriæ later in the common years, and *seven* feriæ later, (that is, on the same feria as Jan. 1,) in leap-years; and so on, through the rest of the months.

This constant quantity, which together with the Concurrent or feria of Jan. 1 thus *regulates* the feria of the first day of every other month in the year, may be called the *Regular* or *Regulator* of the feriæ of the month, in each instance, and therefore the *regular* of the month: and the feria of Jan. 1

being determinable from the Concurrent of the year alone, that of the first day of every other month will be determinable by means of this Concurrent and the Regular of the month in conjunction. And we should thus see that, for the common end and purpose of determining and pointing out the feria of the first day of every month, the Concurrents and Regulars must meet together, must *concur* perpetually; must work in conjunction, and produce the desired effect, one by the help of the other: which would be abundantly sufficient to explain the name given to each.

Scheme of the Regulars in conjunction with the Concurrents in every year of the Cycle of 28.

Regular.			Regular.		
Of January.	Concurrent of the year of the cycle.		Of July.	Concurrent	+6
			August.	—	+2
February.	Concurrent	+3	September.	—	+5
March.	—	+3*	October.	—	+7
April.	—	+6	November.	—	+3
May.	—	+1	December.	—	+5
June.	—	+4			

N. B. In leap-years, +4, and so on in each of the months which follow; the same number increased by unity.

Thus, in the above scheme of Concurrents and in the first year of the cycle, when the Concurrent of January is 0 and the feria of Jan. 1 is the *feria septima;* the feria of Feb. 1 is 0+3 or the *feria tertia:* that of Oct. 1 is 0+7, or the *feria septima,* also: that of Dec. 1 is 0+5, the *feria quinta:* as the Dominical letter of the year, B, shews in each instance also. In the first leap-year of the cycle the Concurrent being 3, the feria of Jan. 1 is the *feria tertia,* as the Dominical letters FE in that year shew it to be: the Regular of February is 3+3 or 6, and the first of February is the *feria sexta,* as the Dominical letter F also shews it to be: the Regular of March is now 3+4 or 7, and the first of March is the *feria septima,* as the letter E, which begins to serve after Feb. 29, shews it to be: the Regular of April is 3+7 or 10−7, i. e. 3; and the first of April is the *feria tertia;* as also is indicated by the letter E: and so on, through the rest of the months, to the end of the year.

SECTION IV.—*On the Solar Cycle of Chronology, and on the Concurrents and Regulars adapted to that.*

If however, instead of the scheme of Concurrents exhibited *supra*, (which is that of the Solar Cycle of the fixed Julian Type of our own Fasti,) we propose the actual solar cycle of the Julian calendar, such as it has been handed down traditionally, and the system of Concurrents adapted to it; we shall find the state of the case to be very materially altered.

This cycle begins in the xxth year of the former; and the former in the xth of this. In juxtaposition they stand as follows.

TYPE I. *True Julian Solar Cycle, with the Concurrents and Dominical Letters.*

TYPE II. *Actual Julian Solar Cycle, with the Concurrents and Dominical Letters.*

A. D.	Year.	Dom. Letter.	Concurrents.	Year.	Dom. Letters.	Concurrents.
*225	i	B	0	x	B	5
26	ii	A	1	xi	A	6
27	iii	G	2	xii	G	7
*228	iv	FE	*3	xiii	FE	*1
29	v	D	5	xiv	D	3
30	vi	C	6	xv	C	4
31	vii	B	7	xvi	B	5
*232	viii	AG	*1	xvii	AG	*6
33	ix	F	3	xviii	F	1
34	x	E	4	xix	E	2
35	xi	D	5	xx	D	3
*236	xii	CB	*6	xxi	CB	*4
37	xiii	A	1	xxii	A	6
38	xiv	G	2	xxiii	G	7
39	xv	F	3	xxiv	F	1
*240	xvi	ED	*4	xxv	ED	*2
41	xvii	C	6	xxvi	C	4
42	xviii	B	7	xxvii	B	5
43	xix	A	1	xxviii	A	6
*244	xx	GF	*2	i	GF	*0
45	xxi	E	4	ii	E	2
46	xxii	D	5	iii	D	3
47	xxiii	C	6	iv	C	4
*248	xxiv	BA	*7	v	BA	*5
49	xxv	G	2	vi	G	7
50	xxvi	F	3	vii	F	1
51	xxvii	E	4	viii	E	2
*252	xxviii	DC	*5	ix	DC	*3

SECTION V.—*Remarks.*

We have annexed the cycle of the Dominical letter to the second of these Types, as well as to the first; but it should

be observed that, when the system of Concurrents in this cycle was first devised, the Dominical letters, in all probability, had not yet been contrived.

These two schemes of Concurrents, in one and the same period of 28 years, being compared together; every one must perceive at a glance that there is a standing and perpetual difference between them: viz. that the Concurrents in the second are invariably *two* numbers lower than those in the former, in every year of the period alike. Thus, in the *first* year of the second, which is the *twentieth* of the first, the Concurrent is 0=7; in the corresponding year of the other, it is 2. In the *first* year of the first, which is the *tenth* year of of the second, the Concurrent is 0=7: in the same year, in the second, it is 5 : and so on, in every other instance.

It is manifest then that, were it proposed, by the help of the series of Concurrents, thus exhibited in the second of these Types, to find the actual feria of January 1 in any year of the cycle of 28; this problem could never be solved by means of this Table merely. It would invariably issue out in an error of *two feriæ* in comparison of the truth; and an error of defect to that extent, in comparison of the truth, not one of *excess*. The result of repeated experiments, and of repeated attempts to solve such a problem by means of this Table merely, and the examination of every year of the period in its turn, would be to lay it down, as an indispensable preliminary to any such use of the Table, that to the proper Concurrent of every year, as indicated by this Table, *two* must be added, to enable it to shew the feria of January 1 in that year correctly: but supposing this to have been done in the first instance, this Table of Concurrents, including the constant of 2 in each, was safely to be trusted, and would indicate the feria of January 1, in every year of the period of 28, with equal truth and exactness perpetually.

The comparison of the two Types however will shew at once that this necessity of the addition of a constant to the Concurrent of the year in the second, and that constant the number 2, was purely the consequence of beginning the scheme of Concurrents in this second in the *twentieth* year of the first Type; instead of in the first: and that this number 2 itself was nothing more or less than the Concurrent of that

very year, which in the other scheme, as setting out in this year from o or zero, was overlooked and not taken into account; the effect of which oversight and of which omission could not fail to be, that the entire sequence and series of Concurrents, in the second Table, deduced from this hypothetical zero or o, would be *two* numbers in *defect* of the truth. And whatsoever it might be, which led the authors of this second scheme to fix on the twentieth year of the other cycle as the first of their own, and whensoever the scheme itself, adapted to such an assumption, was digested; one thing is certain: viz. that the result must have been just the same, so far as the truth was concerned, even had they fixed on any other year of the first cycle, different from this, as the first of their own, except the first of all. Their entire system must have been found to be in error, in that case too, as much as in this, by a constant amount either more or less than 2; and must have required a standing correction, either greater or less than 2, to make it agreeable to the truth.

SECTION VI.—*On the inference, deducible from these facts, of the true order of the Solar Cycle.*

It is this fact, and this alone, which supplies the proof, above adverted to[e], of the existence of an actual cycle of 28 years, the true solar cycle of annual Julian time in the Æra Mundana from the first; a cycle altogether the same as the Solar Cycle of the Fasti: *de facto* so from A. D. 225 downwards in the annual reckoning of annual Julian time itself, and virtually so, and in effect, from the first. At least this fact is demonstrative of *thus much;* viz. that there can be no cycle of 28 years, adapted to the Julian reckoning of annual time perpetually, since A. D. 225, but this. Had there been any such, the essays, experiments, and trials[f] of the authors of this system of Concurrents, whosoever they were, would have discovered it at last; and the hypothetical system, or substitute for the true, in which they were obliged to acquiesce as the result of all their pains[f], would not turn out, as it has done, to be the true, only not in its natural and proper form. But it demonstrates also that, if this cycle makes an actual part of the decursus of true annual time

[e] Supra, p. 149. [f] Daunou, Tome iii. p. 339. &c. Leç. x.

from A. D. 225 downwards, it must have done so from B. C. 4004 until then. It concurs at least with every other proof to the same effect already produced, to establish the conclusion that the actual epoch of the actual reckoning of annual Julian time, as it is going on at present, is this year A. D. 225; and that none other can be so but that: and this is a very important conclusion.

The system so contrived and so elaborated, after an infinity of trouble and labour and patience bestowed upon it, (such at least is the judgment of the learned and eloquent Daunou[g],) was acquiesced in at last only because it agreed with the other, and was in fact tantamount to it. "On se servoit des Réguliers avec les Concurrens"...observe the authors of the Art de vérifier les dates[h], "pour trouver quel jour de la semaine tomboit le premier de chaque mois." And the Dominical letters are intended for no other purpose. "Pour cela," they continue, "il faut ajouter les Réguliers du mois aux Concurrens de l'année." The scheme of the Regulars in this system in the common years of the cycle of leap-year was of course as follows: 2 numbers higher in each instance, than that which we proposed above[i].

Regulars of the months in the common years of the cycle of 28 years, or Solar Cycle commonly so called.

Regular of January,	2	Regular of July,....	1
February,	5	August,..	4
March,	5	September,	7
April,..	1	October,..	2
May,....	3	November,	5
June,..	6	December,	7

Each of these in its turn, being added to the Concurrent of the year, gave the feria of the first day of its proper month, correctly; seven only, if necessary, being first cast off from the sum. In the leap-years of the cycle, after January and February, each was to be increased by unity, if the leap-day itself was Feb. 29. But, according to this system in general, the leap-day followed the old Roman rule of coming in February after the vi kal. Mart. in the shape of vi kal. Mart. repeated, that is Feb. 24 Roman repeated = Feb. 25

g Lectures, loco citato. h Preliminary Diss. p. xxvii. sqq. § xv. i Page 175.

modern: so that, strictly speaking, though the augmentation of the Regular could not apply before March 1, the change of the style of the feriæ in the days of the month took place on Feb. 26.

We shall conclude therefore this part of our remarks with exhibiting the scheme of Concurrents and Regulars, both as they ought to be according to the true solar cycle of the Julian year, and as they are *de facto*, and always have been, agreeably to the above assumptions, in the solar cycle of chronology.

Synopsis of the Concurrents and Regulars, both in the true Solar Cycle of the Julian year, and in the Solar Cycle of chronology.

Year.	Dom. Letter.	Conc. True.	Conc. Actual.
*i	GF	*2	*0
ii	E	4	2
iii	D	5	3
iv	C	6	4
*v	BA	*7	*5
vi	G	2	7
vii	F	3	1
viii	E	4	2
*ix	DC	*5	*3
x	B	0	5
xi	A	1	6
xii	G	2	7
*xiii	FE	*3	*1
xiv	D	5	3
xv	C	6	4
xvi	B	7	5
*xvii	AG	*1	*6
xviii	F	3	1
xix	E	4	2
xx	D	5	3
*xxi	CB	*6	*4
xxii	A	1	6
xxiii	G	2	7
xxiv	F	3	1
*xxv	ED	*4	*2
xxvi	C	6	4
xxvii	B	7	5
xxviii	A	1	6

REGULARS.					
True.			Actual.		
January, Concurrent of the year.			January, Concurrent of the year		+ 2
February, Concurrent of the year		+ 3	February, Concurrent of the year		+ 5
March	—	+ 3*	March	—	+ 5*
April	—	+ 6	April	—	+ 1
May	—	+ 1	May	—	+ 3
June	—	+ 4	June	—	+ 6
July	—	+ 6	July	—	+ 1
August	—	+ 2	August	—	+ 4
September	—	+ 5	September	—	+ 7
October	—	+ 7	October	—	+ 2
November	—	+ 3	November	—	+ 5
December	—	+ 5	December	—	+ 7

* In the leap-year, add 1 to all the Regulars after February.

CHAPTER VI.

On the order of the Dominical Letters in the Solar Cycle, and why it is retrograde, not progressive.

SECTION I.

As there are only seven different feriæ in the hebdomadal cycle, there are only seven possible cases of the incidence of the first of January in the order of feriæ; and, if the particular form of the incidence in one of these cases was to be distinguished from another by a particular symbol, it would be an obvious idea to borrow these symbols from the first seven letters of the alphabet. This, it appears, has been done: the fact being notorious, and incapable of contradiction, that the first seven letters of the alphabet have been from time immemorial, and still are, used for that purpose.

It must therefore strike every one, even at first sight, as something extraordinary and not to have been expected *a priori*, that, while the idea of making this use of the first seven letters was so natural and so obvious, the use which has actually been made of them, and still is, should be contrary to nature, and the last to suggest itself; for the first seven letters of the alphabet, as every one knows, as letters of the alphabet run on from A to G: as signs or symbols of the incidence in question, (i. e. as the Dominical letters, not as letters of the alphabet,) they run on, and are read perpetually, from G to A.

It adds to the surprise that the first case of the incidence in question, which could properly happen in any year of the cycle in which the incidence runs through all its forms, and which case, it might be supposed, would determine the law or rule of the rest; i. e. the case of the incidence of the *first* day of the *year* on the *first* feria of the *week*; should have for its particular symbol the first of the letters of the alphabet, A: and yet that the next of occurrence to that, and the most directly dependent on it, the incidence of the *first* day of the year on the *second* day of the week, should have for its symbol the letter G. What was more naturally to be expected

than that, if A was to be considered the fittest symbol of the incidence of the 1st of January on the feria prima, B should be reckoned the fittest for that of January 1 on the feria secunda? In what respect was G, the seventh letter of the alphabet, better qualified to represent this incidence, than B, the second? or what difference could it have made to the meaning or use of these symbols in general, if they had run on forwards, from A to G, instead of backwards, from G to A, perpetually?

SECTION II.—*Analogy of the use of the letters of the Alphabet in the Roman Calendar, for the Feriæ of the Nundinal Cycle.*

The idea of applying the letters of the alphabet to this purpose of symbolising and representing particular forms of the incidence of the first day of the year on the days of the week could be nothing new at Rome; or wheresoever else the Julian calendar, properly so called, was in use. Long before this contrivance of the Sunday letters, the letters of the alphabet had been employed in a similar manner at Rome; and this kind of application thereof had long been exemplified in the Roman calendar.

The Romans had *their* week, as much as the Jews and the Christians of antiquity; only the Roman week was one of eight days, that of the Jews and Christians is and always was one of seven. This Roman week was the Nundinal Cycle of ancient Italy; a cycle incorporated in the Roman calendar from a much older calendar, in the time of their founder Romulus: a cycle retained and perpetuated in the calendar of Numa Pompilius, when that superseded the calendar of Romulus: a cycle which ran through every subsequent change of the calendar, from Numa to Julius Cæsar, with an unbroken thread; and at the time of the correction of Cæsar itself, (to which we ultimately owe not only the Julian but also the Gregorian calendar of the present day,) by a remarkable coincidence, yet still only in point of fact the consequence of the regular law of the cycle until then, was found to be attaching itself to the first kalends of January in the first Julian year: a cycle, which we can

trace with the same regularity and the same inviolability as before, for 400 years after the correction of Cæsar itself[k].

Now there is not a single fragment of the Julian calendar of Cæsar in existence, and whether more or less perfect in itself, which does not furnish the same proof of *this one* fact; viz. That the letters of the Roman alphabet, from A to H, made part of the details of the Julian correction: running on in that order perpetually, all through the year, from the kal. Jan. or Jan. 1 Roman to prid. kal. Jan. or December 31 Roman. And as these *eight* letters of the alphabet, from A to H, were exactly the measure of the nundinal cycle (the *orbis nundinalis*) of the Romans, just as the first seven from A to G are that of the hebdomadal cycle; no one can hesitate to infer from this coincidence, that this cycle of letters must have been intended to symbolise the nundinal cycle; and each letter in the former to be the representative of one of the feriæ in the latter, A of the first, B of the second, and so on—as far as H.

There is a very valuable monument of this kind, (almost a perfect exemplar of the Roman correction of Cæsar, as it stood, at least, in the fourth century of the Christian æra,) of which we shall have occasion to give a particular account, if we ever come to treat in detail of the Julian correction. Its date is A. D. 355. It was set up and made public at Rome in that year. It is adapted at least to that year, and to that exclusively. In this contemporary monument, the hebdomadal cycle of Christianity, and the nundinal cycle of antiquity, are both incorporated, and both represented at once; though, (as was naturally to be expected in a monument of such a date,) precedence and prominence are very significantly given to the hebdomadal over the nundinal combined with it.

But the mode of the representation of both is that with which we are chiefly concerned at present. The hebdomadal cycle is denoted by the first seven letters of the alphabet, the nundinal by the first eight; yet each by these letters in their natural order: the matter of fact, A. D. 355, being this, That, owing to a very singular concurrence of circumstances, which, in the regular administration of two such

[k] See our Fasti Catholici, i. 503. Diss. vi. ch. v. sect. iii.

cycles as the hebdomadal and the nundinal, in a calendar like the Julian, could not happen more than once in 896 years, the first feria of the hebdomadal cycle, and the first feria of the nundinal, both met together on the first day of the civil year, the kalends of January U.C. 1108, the 1st of January A.D. 355, in the third year of the Julian cycle of leap-year.

This is a clear case to shew that neither could the idea of using the letters of the alphabet as symbols of the different forms of the incidence of the days of the year on the days of the week have been any thing new at Rome, long before the contrivance of the Sunday letters; nor was the first idea of that use contrary to nature, or the first use and application of such letters as such symbols contrary to the order of the letters themselves.

SECTION III.—*Probability of some explanation of the anomaly in question.*

It makes no difference, it is true, to the actual use and effect of such symbols, in what order the letters from which they are taken are read. A positive appointment, howsoever arbitrary or even capricious, in a case like this, once distinctly made and understood, and ever after observed accordingly, would have answered its purpose as much as the most natural. Still, if it is to be presumed that when men were free to choose their own course they would not deliberately prefer to do a thing in an unnatural way, and contrary to their first impulses, which might have been done just as well in a natural way, and in conformity to the first suggestions of common sense; it may fairly be taken for granted that, if the conventional rule of the Dominical cycle at first sight offends against common sense, and yet might have attained the same end and answered the same purpose, without appearing to do so in any manner whatsoever: there must have been some reason for it. The authors of the rule, whosoever they were, were not left to their own discretion. They had no alternative except to fall in with something else, which could not be disturbed; and to adapt their own rule accordingly.

It remains to be considered then whether any such neces-

sity is discoverable. The question at least is curious and interesting; and we have never yet met with any attempt to answer it. Why is the order of the Dominical letters contrary to the order of the alphabet? Why are the letters in that cycle read backwards perpetually, and not forwards? No one seems to have thought it worth his while to inquire into this point. And yet the answer to this question will both confirm the preceding account of the system of Concurrents and Regulars; and also, if we are not mistaken, will throw light on a confessedly obscure and doubtful point, the date of the first introduction into use of the Dominical cycle itself.

SECTION IV.—*The system of Concurrents older than the Dominical Cycle; and the Solar Cycle older than the system of Concurrents.*

We apprehend it may be taken for granted that the system of Concurrents and Regulars, explained above, is older than the contrivance of the Dominical Letters; for this reason, viz. That both are intended to answer the same end and purpose, and both do actually answer the same; but the latter directly and at once, the former indirectly and by making use of more means than one. It would be contrary to probability that, if men were already in possession of an easy, compendious, and infallible means of effecting a certain purpose, they should have set themselves deliberately about the contrivance of another, which was neither more simple nor more expeditious, though it might not be less certain. Had the Dominical letters then been already thought of and already in use, the scheme of Concurrents and Regulars, it is to be presumed, would not have been invented, because it would not have been wanted.

Again, this scheme of Concurrents itself after all being only the cycle of the hebdomadal epact, or the progressive advance of the first of January in the order of feriæ through the several years of the solar cycle of 28 years; it presupposes this cycle: and if the cycle, to which it is thus attached and from which it is thus inseparable perpetually, had not been previously laid down and defined in some manner or other *unalterably,* had not been fixed and determined so as

no longer to be disturbed or changed, the system so adapted to it, it is to be presumed, either could not or would not have been devised.

These two conclusions then, one that the system of Concurrents and Regulars is older than the Dominical Cycle, the other that the Cycle of 28 years, to which this system of Concurrents is attached, is older than that system itself, being laid together; we are probably furnished with all the data which we require for the solution of the question proposed.

Section V.—*On the probable explanation of the phenomenon.*

It appears from the schemes exhibited supra[1], both that of the true order and value of the Concurrents in the true cycle of 28 years, and that of their assumed order and value in the common solar cycle, that the Concurrents alone in the former, and the Concurrents along with the constant of 2 in the latter, are absolutely the same as the Dominical letters; that the Dominical letters are the Concurrents under a different name; and that both the Concurrents and the Dominical letters, when similarly applied to the first day of the year, intimate just the same thing concerning its relation to the days of the week: the Concurrents at once, by means of their numerical value, the Dominical letters mediately, by virtue of the conventional sense and meaning of a positive sign.

The Dominical letters then, whensoever they were introduced, being only the equivalents of the Concurrents, or of the Concurrents and Regulars; let us next take into consideration the fact that the cycle of 28 years, to which both have always been attached, was older than each, and for some reason or other was so fixed and determined in a certain way, that it could not be altered. It is peculiar to this cycle, as we have seen, to take its rise in the *twentieth* year of the period of the same kind, instead of the first. It is a necessary consequence, on the other hand, of the course and advance of the first of January among the feriæ of the week in the true cycle of the same kind, that in the 20th year of this cycle its place must be and will be the 2d of the days of the week. No power or appointment of man can interfere

[1] P. 180.

with this coincidence, which depends on the relation of the noctidiurnal cycle to the hebdomadal, and on that of both to the annual from the first. No positive or arbitrary arrangement of the parts of the true cycle, (i. e. the period of 28 years from the first,) can prevent this particular coincidence from taking place at the proper time perpetually. It follows that, in the xxth year of the true cycle, the first of January must be the feria secunda. The case will not be altered by the xxth year's being mistaken for the first; or only so far that, on this principle, as the revolution of the first of January among and through the feriæ of the week, in the different years of the period of 28 years, will set out from the feria secunda, so it will return to the feria secunda, perpetually.

Let it be supposed then that all this having been previously ascertained in point of fact, and a system of Concurrents and Regulars, adapted to such a state of the case, having been previously digested, and reduced to practice; it was considered advisable at last to dispense with it, and to substitute something else in its stead; and that this was the Dominical cycle. The first question would be, On what letters to pitch as the constituent parts of this cycle? And that would be soon decided. Seven letters being all that were wanted, the first seven letters of the alphabet would be the first to suggest themselves, and the first to be taken.

The next question would be, In what order to apply them, and to make them circulate perpetually? And this might occasion some perplexity at first; yet it is easy to see in what manner it would be probably determined at last.

For the actual matter of fact being *this*, that in the first year of the cycle of 28 years the first of January both was and must be the feria *secunda*, not the feria *prima*; the problem which had to be solved was manifestly this, By which of the seven letters of the alphabet was this first and most cardinal form of the incidence to be first represented?

If the first of January had begun with falling on the feria *prima*, no letter could have appeared so proper to symbolize that form of the incidence as A: and we may take it for granted that A in this case, or at least A B (the first year of the cycle being leap-year), would have been appointed the first of the Sunday letters. And in that case too, C we may

conclude would have been constituted the Sunday letter of the second year, D that of the third, and so on, in the order of the letters of the alphabet, in the order of the feriæ of the week, and in the order of the years of the period of 28, all alike.

In point of fact however the first of January, in the first year of the cycle, was falling on the feria secunda, not on the feria prima; and to have made the letter A the symbol of that incidence would have been liable to *this* objection, That while the alternation of the days of the year in the order of feriæ was setting out from the feria *secunda*, the succession of characters, designed to accompany that alternation and to symbolize it perpetually, was setting out from the *first* of these symbols themselves, according to their natural order of succession in the alphabet from what they were all taken.

This objection would very probably appear to be of weight. But if this particular form of the incidence, for such a reason as that, was not to be represented by the letter A, much less was it to be so by the letter B; unless it had been determined to leave the first letter of the alphabet in the cycle of symbols, borrowed from the alphabet for this particular use and purpose, out of the cycle altogether; and to read the cycle from B to H, instead of from A to G, perpetually.

There would be no alternative left then, except to begin the circle of symbols at the lower end of the cycle of letters, as it could not begin at the upper; that is, to read the letters from G to A, since they could not be read from A to G: and so to set out with G as the symbol of the incidence of January 1 on the feria secunda, that is, in the first year of the cycle; and to pass to E as the symbol of the incidence in the second year on the feria quarta, and so on. And although the order of the letters, on this principle, must be retrograde perpetually, yet this coincidence would result from this constant retrogradation of the characters at last, that in the last year of the period of 28 years, when the first of January, by virtue of the law of progression in and among the feriæ of the hebdomadal cycle to which it was constantly subjected, would be found to be actually falling on the *feria prima;* the symbol of this incidence, in the constant circula-

tion and alternation of the letters, would be found to be actually A also. And thus both the first and most natural form of the incidence, and the first and most legitimate symbol of that incidence, would be found meeting in the last year of the period, if not in the first, perpetually.

We propose this therefore as the most probable explanation of the phenomenon into which we are inquiring; the use of signs, taken from the alphabet, to represent the incidence of the first day of the year on the days of the week through every year of the period of 28 years, which follow the order of the period and the order of the incidence and the order of feriæ, but do not follow the order of the alphabet. It is resolvable ultimately into the fact that the cycle of 28 years being previously fixed and determined unalterably; the first form of the incidence was thereby fixed and determined unalterably also to the feria secunda: and the last to the feria prima. The first of the symbols therefore, in the natural order of the alphabet, was purposely reserved for this last; and consequently the last of the same symbols in the same order must necessarily be appropriated to the first. If so, the symbols themselves must go backwards in the order of the alphabet, not forwards, perpetually. Every one however is at liberty to think of this explanation as he pleases.

SECTION VI.—*On the probable date of the introduction of the Cycle of the Dominical Letter into use.*

We have approximated so far to the discovery of an answer to this question, that we may safely conclude the Dominical letters cannot be older than the system of Concurrents and Regulars at least; nor this than the solar cycle of chronology. As to the actual date of the introduction of these letters, it is involved in much obscurity. We have sought for information on this point; but have not been able to meet with any. In the elaborate work of the learned and indefatigable authors of the "Art de vérifier les dates" nothing occurs, calculated to throw light on the origin of this cycle of the Dominical letters; where it was first contrived, or by whom, or when it first appeared, and the like.

It is true, we meet with a statement in Scaliger[m], which would be decisive upon this question, had it any foundation to rest upon; and would invest this cycle with an high degree of antiquity, and a still higher degree of authority: viz. That it was contrived and introduced into use under the auspices of the council of Nice, A. D. 327. But we know of no ancient authority for this statement; and it appears to us to be contradicted even by what Scaliger himself observes in another instance, that the use of the Dominical letters was confined to the church of Rome, that is, we may presume, at the utmost to the west: whereas a constitution and ordinance of the council of Nice must have been as generally known, and as commonly received and adopted, in the east as in the west. Sola ecclesia Romana utitur litteris quas Beda vocat laterculum Septizonii, A B C D E F G .... nam aliarum ecclesiarum laterculus non est litterarum, sed concurrentium, qui cum regularibus mensis feriam diei componunt[n]. There is more truth, in our opinion, in the simple confession of Petavius, That he knew nothing of the origin of this cycle: Quandonam institutus sit iste cyclus, compertum non habeo[o]. All that appears to be known of its history at least is no more than *this*: That Venerable Bede in particular was acquainted with it, and means it when he speaks of the laterculus Septizonii or Septizodii[p]: and as he died in A. D. 731, it is manifest that the invention and publication of the cycle, to be known to him, cannot have been later than the 7th century of the Christian æra.

SECTION VII.—*Probable connection of the invention of the Dominical Cycle, with the Paschal Controversy of ecclesiastical antiquity.*

We entertain little or no doubt ourselves that both the solar cycle, to which the system of Concurrents and Regulars which we have explained was always attached, and this sys-

m Canones Isagogici, lib. iii. 178. IIII. ad principium. Thesaurus Temporum.

n Ibid. iii. p. 181. X.

o Doctrina Temporum, lib. vi. cap. xxvii. pag. 602. Lutetiæ Paris. MDCXXVII.

p Scaliger, Canones Isagogici, lib. iii. 176. V. 181. X.: Art de vérifier les dates, Preliminary Diss. § xvii. pag. xxx. note 3.

tem itself, and the cycle of the Dominical letters which ultimately supplanted it, are all to be traced up to the Paschal controversy, which agitated the church for so many centuries, and to the different Paschal rules, which so long contended with one another for the ascendancy.

The most famous of these rules were the Roman and the Alexandrine; and these two may be said to have divided the practice of the church between them. We hope, in the course of our Origines Kalendariæ, to have a proper opportunity of giving the necessary account of each. The Paschal cycle, most commonly associated with the observance of the Roman rule, was the cycle of 84 years: that which generally accompanied the Alexandrine was the cycle of 19 years. The period of 28 years enters directly into the former; 28×3 being equal to 84: and in the shape of the period of 532 years, the product of 28 and 19, commonly called the Victorian, it combines itself with the latter also. And though this period derives its name from Victorius, (or as Scaliger styles him[q], Victorinus,) of Aquitain, who published a great Paschal Cycle or Canon of that description, in A. D. 457; in reality it was older than his time: and had already been applied to the same purpose, if not to the measurement of time generally, by the Egyptian monk Annianus, if not by Panodorus also; both contemporaries of Theodosius the Great, or of Arcadius his son[r].

After a long and doubtful struggle the Alexandrine rule had succeeded in establishing its supremacy even at Rome, by the time of the publication of the Paschal Canon of Dionysius Exiguus; which was properly a period of 95 years, or 5 Metonic cycles: resembling in that respect the Paschal Canon of Theophilus Patriarch of Alexandria, made public A. D. 385, but set back purposely to A. D. 380; and the first of its kind the historical date of which is known: and that of Cyrill his nephew, and successor in the same see, published in A. D. 437. Dionysius' own canon was expressly

[q] De Emendatione, ii. 160 A.

[r] Syncellus, 62. 3: 62. 18: 63. 9: 617. 18. From this account of Syncellus, it appears that Annianus' period of 532 was a Paschal canon, the epoch of which was attached to A. M. 5534 of his chronology; the date of the Resurrection and of the first Christian Easter. Syncellus himself applies the period to the measurement of time from the creation downwards: see 18. 3: 29. 18, &c.

intended to take up and continue this for another period of 95 years; though for particular reasons he chose to fix its epoch to A. D. 525, seven years before the proper expiration of Cyrill's, A. D. 532.

This canon of Dionysius was easily to be expanded into the period of 532 years; the cycle of 19 entering alike into both. The year which he selected for its publication, as we have observed, was A. D. 525, in which, according to his own rule, the Golden number was xiii, the luna prima March 11, and the lunar 14th March 24: and the Dominical letter being E, Easter Sunday was March 30. But the proper lunar epoch of his cycle is to be traced back to the nearest mean or actual new moon, to August 29—the new year's day of the Alexandrine solar and Julian calendar; which A. D. 284 would be, or might be, August 29 itself, and A. D. 524 would be August 16 or 17. And this being the case, the first year of a period of 532 years containing 19 lunar and 28 solar cycles, founded on such a lunar cycle as this, according to the proper Roman rule, which reduced every thing of this kind to the kalends of January, might be dated either on the kalends of January A. D. 525, or on the kalends of January A. D. 524.

Now this latter year, A. D. 524 ex kalendis Januariis, as our Fasti shew, was the 20th year of the 162d cycle of 28 years, brought down from the beginning of things, and the 20th of the 10th brought down from A. D. 225. It follows from this state of the case that a period of 532 years, embodying the solar cycle of 28 years and the lunar cycle of 19 years and the Paschal rule of Dionysius all at once, being supposed to have come into being at this time, either on January 1 or on the day after the bissex in February, A. D. 524; would actually take its rise in the 20th year of the true cycle of 28 years, and yet embody a proper cycle of that kind of its own, too. It follows also that, if this period of 532 years, thus dated Jan. 1 or Feb. 26 A. D. 524, were assumed to be only a continuation of another similar and older period, which expired at this same time; to find the epoch of this prior and older period, we should have to go back to Jan. 1 or Feb. 26 B. C. 9. It is well known that the first year of the solar cycle, last before the beginning of the

Æra Vulgaris in the style of After Christ, is B. C. 9: and A. D. 1 itself is the 10th year of that cycle. It would be very natural to set back a Paschal period of 532 years, from A. D. 524 to B. C. 9; in order to include in it the whole of the interval comprehended by the facts of the Gospel history. And the lunar and solar characters of this first period would be assumed to be identical with those of the second; though in reality they could not be absolutely so, especially the solar. The lunar however would differ only by one day; as our own lunar calendar, for these two years, B. C. 9 and A. D. 524, compared with each other, will shew.

It appears to us that these coincidences do much to explain the origin of the common solar cycle of 28 years; in particular how it came to be attached from the first to the *twentieth* year of the true: and also to verify the historical tradition that both this cycle and the cycle of the Dominical letters first took their rise at Rome, where the Paschal canon of Dionysius itself was first published. They seem too to lead to the inference that both the fixation of this cycle, and the invention of the Concurrents and Regulars, and the ultimate substitution of the Dominical letters in their stead, are to be comprehended between A. D. 525 and the end of the seventh century; which is probably all that can ever be known about them with certainty at present: though we do not undertake to say that even thus much is certain.

INTRODUCTION TO THE TABLES.

PART III.

CHAPTER I.

Supplementary Tables of the Fasti.

SECTION I. Table i.—*Ingresses of the mean sun into the twelve months of the mean tropical year, and of the Calendar of Mazzaroth.*

THE mean length of the tropical year being assumed at 365 d. 5 h. 48 m. 50 s. 24 th. the twelfth part of this year is 30 d. 10 h. 29 m. 4 s. 12 th. Table i is constructed on this datum. The ingress of the mean sun into the first month of this tropical year, (i. e. the mean vernal equinox,) is shewn by the solar cycle of our Tables (division B), for the proper meridian, that of Jerusalem, *in annis expansis* from A. M. 1 B. C. 4004 downwards; the ingresses into the rest of the months, in a given year, whensoever they are required, may be obtained by the addition of the dates in this Table i to that primary ingress in the given year.

The ingresses thus obtained are the mean ingresses. The true are to be known only by means of the equation of the centre applied to the mean. The equation of the centre is explained by astronomers to denote the difference of the sun's mean place and the true. The argument of this equation is the sun's mean anomaly; i. e. the mean longitude of the solar apogee or solar perigee subtracted from the sun's mean longitude. This argument can always be found from our Tables; the sun's mean longitude (S L) from Table i,

the mean longitude of the apogee (A L, or A L increased by 180°, that of the perigee) from Table v, Part i and ii: and therefore the mean anomaly (S A) may always be found from our Tables. But the equation of the centre cannot be found from any of our Tables except Table xxi, Part vii; which we have borrowed from Ferguson's Astronomy edited by Brewster A. D. 1811: and from that too only approximately or within certain limits of the truth. If the true ingresses therefore are required with any degree of exactness, the equation of the centre must be calculated expressly for the circumstances of the case; and for that purpose we ourselves have generally made use of Delambre's Tables of the epoch of A. D. 1810, along with Table v Part i and ii, and our own Solar Tables, of which we shall give an account by and by; these latter supplying the mean anomaly, and Delambre's the equation of the centre corresponding to it.

The equation of the centre is necessarily found in the first instance in terms of the ecliptic circle, (in angular motion, or an arc of the sphere, in degrees, minutes, and seconds); but it is easily reduced from angular motion to time by means of Table viii, Part i and ii. When the sun is moving from apogee to perigee, (i. e. S A or the mean anomaly (S L–A L) is less than six signs or 180°,) the true place is behind the mean; and the equation of the centre (E) in arc is *negative* in time is *positive*: i. e. the equation reduced to time from Table viii must be added to the mean ingresses found from Table i. When the sun is moving from perigee to apogee, (i. e. S L–A L or S A is greater than 180°,) the mean place is behind the true; and the equation in arc is *positive* in time is *negative*: i. e. being reduced to time by means of Table viii it must be subtracted from the mean ingresses of Table i.

The primary ingress, division B of our Tables, being dated exactly at midnight[s], the mean ingresses for the rest of this year, (the first which enters our Tables, the first year of mundane time itself, A. M. 1 B. C. 4004,) are shewn by this Table at once. The mean and the true ingresses into the first month of each of the quarters of this first year of mundane time, by means of Table i and Table ii, may be exhibited as follows.

[s] On this subject see Vol. iv. Appendix. ch. i.

Mean and true Ingresses into each of the four quarters of the tropical year, A.M. 1 *B.C.* 4004, *for the meridian of the ancient Jerusalem.*

			h.	m.	s.	th.
i.	Mean Ingress into the first quarter. Table i.	April 25	0	0	0	0
	Equation of the centre. Table ii Part ii.	±	0	0	0	0
	True Ingress or V. E.	April 25	0	0	0	0
ii.	Mean Ingress into the first quarter ..	April 25	0	0	0	
	One quarter. Table i	91	7	27	12·6	
	Mean Ingress into the second quarter ..	July 25	7	27	12·6	
	Equation of the centre	+ 1	16	23	37·558	
	True Ingress or S. S.	July 26	23	50	50·158	
iii.	Mean Ingress into the first quarter ..	April 25	0	0	0	
	Two quarters	+ 182	14	54	25·2	
	Mean Ingress into the third quarter ..	Oct. 24	14	54	25·2	
	Equation of the centre	+ 0	0	18	37·642	
	True Ingress or A. E.	Oct. 24	15	13	2·842	
iv.	Mean Ingress into the first quarter ..	April 25	0	0	0	
	Three quarters	+ 273	22	21	37·8	
	Mean Ingress into the fourth quarter ..	Jan. 23	22	21	37·8	
	Equation of the centre	− 2	5	17	14·951	
	True Ingress or W. S.	Jan. 21	17	4	22·849	

With regard to what we mean by the Calendar of Mazzaroth, we refer our readers to our general work[t]. The names of the months in this calendar are the Greek names of the signs of the ecliptic more or less modified according to the same rule. The first person who appears to have employed these names so modified, and in this sense as the representatives of the signs, was Dionysius, an astronomer of antiquity; whose observations of certain of the planets, (especially of Mercury,) Ptolemy has had occasion to quote[u]: and by him they seem to have been regularly connected with a chronological æra also, which he was probably the first to introduce; the epoch of which appears to have been B. C. 285: i. e. the beginning of the reign of Ptolemy Philadelphus in Egypt.

[t] Vol. iii. 250–324. Diss. xv. ch. iii–iv.
[u] See our Fasti, ii. 414–418. Diss. xii. ch. ii. sect. ii.

SECTION II. Table ii. Part i and Part ii.—*Lengths of the four quarters of the tropical year at the ingress of each Julian Period of the Fasti.*

This Table consists of two Parts. The first Part has been calculated from a formula furnished by the Rev. James Challis, M.A., of the Observatory, Cambridge, and Plumian Professor of Astronomy and Experimental Philosophy, and late Fellow of Trinity College, in the University of Cambridge; by whom we have been laid under many obligations of this kind, which we are happy to have this opportunity of acknowledging. The second Part we have calculated ourselves from the Solar Tables of Delambre, with the mean anomaly of our own Tables, on the principle already explained[w].

In this first Part of Table ii however, the lengths of the quarters are reckoned not from the *mean* but from the *actual* ingress of the sun into the celestial Krion; and therefore in order to its application the date of this actual ingress at the beginning of the Period ought to be known: and that would require the equation of the centre for the same point of time also to be known. This desideratum may be considered to be supplied by the second Part; in which the equation of the centre at the beginning of every Period is shewn both in angular motion and in time.

It will be observed that in each of these Parts the sum of the four quarters is a constant quantity; in Part i, 365d. 5h. 48m. 52s.: in Part ii, 365d. 5h. 48m. 50·4s.; which is our own standard of the mean tropical year. It is evident then that these two Parts agree in the sum total of the different quarters perpetually; but it will also be observed on comparison that they do not agree in their details: that is, in the lengths of the different quarters, as shewn by each, at a given time respectively. There is no doubt that this distinction admits of a satisfactory explanation. It is sufficient however for our purpose at present to have pointed out the fact of its existence. The two Tables agree most nearly in all respects at the ingress of Period xliii, A.D. 1261.

It may be assumed without any material error (especially for merely chronological purposes) that, for a limited interval

w Page 195.

of time not greater than one of our Periods, the length of these different quarters increases or decreases in proportion to the length of the Period. The lengths therefore at the intermediate points of the Period may be obtained from those at the beginning merely by interpolation; i. e. by adding or subtracting to or from those lengths at the beginning the proportional parts of the whole difference between one Period and the next; which has been noted in each of these Tables for that purpose.

Thus, to find the lengths of the four quarters, according to Table ii Part i, A. D. 1801, eight years after the ingress of Period xlvii, A. D. 1793. The length of that Period is 112 years; and the total difference in the Period being ∓1h. 55m. 38s. and ±1h. 6m. 32s., the annual difference is ∓61s. ·946 428 57 and ±35s · 642 857; and the former in eight years amounts to ∓8m. 15·571s., the latter to ±4m. 55·143s.

We have therefore Period xlvii A. D. 1793, Table ii Part i:

	d.	h.	m.	s.
Length of the first quarter	92	22	2	53
Eight years' decrement			− 8	15·571
A. D. 1801. Length of the first quarter	92	21	54	37·429
Actual length A. D. 1801[x]	92	21	50	
			+ 4	37·429
Length of the second quarter	93	13	17	25
Eight years' increment			+ 4	55·143
A. D. 1801. Length of the second quarter ..	93	13	22	20·143
Actual length[x]	93	13	44	
			− 21	39·857
Length of the third quarter	89	16	51	33
Eight years' increment			+ 8	15·571
A. D. 1801. Length of the third quarter ..	89	16	59	48·571
Actual length[x]	89	16	44	
			+ 15	48·571
Length of the fourth quarter	89	1	37	1
Eight years' decrement			− 4	55·143
A. D. 1801. Length of the fourth quarter ..	89	1	32	5·857
Actual length[x]	89	1	33	
				− 54·143

[x] Tables and Formulæ of the late F. Baily esq., 21.

SECTION III. Table iii. Part i.—*Mean annual Precession, or increment in the mean Longitude of the fixed stars, from one to* 7000 *mean tropical years.*

Part ii.—*Mean noctidiurnal Precession, or increment in the mean Longitude of the fixed stars, from one day to* 365 *days.*

It has been shewn, in our general work[y], that 25 885 mean tropical years of our standard = 25 884 mean sidereal years; and that 360° divided by 25 884

= 50″·069 541 029 207 232 267.

This therefore is the arc of the Precession, assumed in our Tables; the amount of the recession by which the mean vernal equinox falls back annually on any fixed point of the ecliptic: and consequently the amount of the increment every year so produced in the longitude of the fixed stars reckoned perpetually from the point of the mean vernal equinox. In 2157 tropical years of our standard it accumulates to 30 degrees or an entire sign; and there is every reason to believe[z] that in Egypt in particular this effect was actually observed to have taken place A. M. 2158 B. C. 1847 at the epoch of the first Phœnix period.

This Table is reckoned from the mean vernal equinox to the mean vernal equinox perpetually. It shews the mean increment in the Precession therefore in the mean tropical not in the mean Julian year. The mean noctidiurnal increment corresponding to this mean annual one is best obtained by dividing the total amount of the latter in 4000 tropical years, 55° 37′ 58″·164 116 828 929 068, by the number of days and nights in 4000 tropical years also, which is exactly 1 460 969 (Table xxx). The quotient is

0″·137 085 841 052 636:

and this being the mean rate of the diurnal increment that of the horary will be 0″·005 711 91.

y Vol. iv. 147. Diss. xv. ch. xiii. sect. ix.

z See our Fasti, vol. iii. 269–274. Diss. xv. ch. iv. sect. i and ii.

Required the mean annual Precession in 2157 mean tropical years.

SUPPLEMENTARY TABLES.—TABLE iii. PART i.

		°	′	″
2000 years	=	27	48	59·082 058 414 464 534
100	=	1	23	26·954 102 920 723 226 7
50	=		41	43·477 051 460 361 613 35
7	=		5	50·486 787 204 450 625 869
2157 years	=	29	59	59·999 999 999 999 999 919

There was an ancient tradition among the Egyptians, (the fact of which has been handed down through the Arabians[a],) that at the epoch of the deluge the star Regulus, (Cor Leonis, the principal star in the constellation of Leo,) was standing on or near to the solstitial colure. Let us put this fact to the test by means of the present Table.

We have demonstrated[b] that the true year of the deluge of Scripture was A. M. 1657 B. C. 2348. The longitude of Regulus, according to Flamsteed[c], A. D. 1689 exeunte (Dec. 31 A. D. 1689 at mean noon), was 145° 31′ 20″. We have then

			h.	m.	s.	
i. Mean V. E. of the Tables,	March 10		2	54	57·6	A. D. 1690.
Correction ..	.. +	2	0	11	9·6	
True M. V. E...	.. March 12		3	6	7·2	At Jerusalem.
	−		2	20	47	
	March 12		0	45	20·2	At Greenwich.
	−	70	12	45	20·2	
	Dec. 31		12	0	0	A. D. 1689.

ii. B. C. 2348—A. D. 1690 = 4037 years.

TABLE iii. PART i and ii.

			°	′	″	
	4000 years	=	55	37	58·164	
	30	=		25	2·086	
	7	=		5	50·487	
A. D. 1690	4037	=	56	8	50·737	March 12 0 h. 45 m. 20 s·2 M. V. E. at Greenwich.

[a] Bailly, Astronomie Ancienne, Liv. v. § xxii. p. 414: ix. § xi. p. 483.

[b] Fasti, ii. 166–185. Diss. x. ch. iv.: 236–250. ch. viii: iii. 245–248. Diss. xv. ch. ii. sect. vi.

[c] Catalogus Britannicus, p. 10. Opp. iii. Cf. Delambre, Astronomie Ancienne, ii. 273. 263. 249.

iii. Longitude of Regulus ..	° ′ ″ 145 31 20	h. m. s. Dec. 31 12 0 0	A. D. 1689.
	+ 9·670	+ 70 12 45 20·2	
Longitude of Regulus ..	145 31 29·670	M. V. E. A. D. 1690 at Greenwich.	
91 d. 7 h. ..	+ 12·515		
Longitude ..	145 31 42·185	M. S. Solstice.	
Precession 4037 y. =	−56 8 50·737		
Longitude of Regulus ..	89 22 51·448	B. C. 2348.	
	+ 37 8·552		
	90 0 0·0		

And though this calculation is only an approximation to the truth, it is sufficient, we apprehend, to shew that the tradition in question had a substantial foundation in the matter of fact relating to the actual place of this star, B. C. 2348 at least. Even this tradition therefore may have its weight along with other arguments to the same effect, in confirmation of the true epoch of the deluge of Scripture, which is that of the Hebrew Bible only.

Section IV. Table iv. Part i.—*Mean annual increment in Right Ascension, in hours, minutes, and seconds, from one to* 7000 *mean tropical years.*

Part ii.—*Mean noctidiurnal increment in Right Ascension from one day to* 365 *days.*

It has been shewn[d] that, if we divide 24 hours or 86 400 seconds of mean sidereal time by 25 884, the quotient is 8 s · 337 969 401 947 148 817 8. And this quantity in time multiplied by 15 gives the arc of the Precession assumed in the preceding Table; as that arc divided by 15 gives this quantity in time. It is therefore the mean annual increment in Right Ascension, or in mean sidereal time, corresponding to the mean annual increment in longitude, according to our assumptions.

This Table too is reckoned from the mean vernal equinox to the mean vernal equinox perpetually. The mean diurnal increment corresponding to the annual is 0 sec · 009 139 056: the mean horary is 0 sec · 000 380 794.

[d] Fasti, iv. 147, 148. Diss. xv. ch. xiii. sect. ix.

SECTION V. Table v. Part i.—*Mean annual motion of the Solar Apogee, reckoned from the mean vernal equinox* A. M. 1 B. C. 4004 *to the mean vernal equinox perpetually, from one to* 7000 *mean tropical years.*

Part ii.—*Mean noctidiurnal motion of the Solar Apogee from one day to* 365 *days.*

Table vi.—*Epochs of the Solar Apogee, reckoned from the mean vernal equinox perpetually, at the beginning of each of the Julian Periods of the Fasti.*

The two extremities of the axis major of the solar orbit are called the Apogee and the Perigee respectively; each of these terms being referred to the sun and to its apparent position relatively to that of the earth. As referred to the earth and to its position in space relatively to the sun, they are called Aphelion and Perihelion respectively. The name of *apsides* is applied to them in reference to both the sun and the earth in common. The Apogee or the Aphelion is that extremity which is most remote from the focus of the ellipse in which the sun is stationed; the Perigee or the Perihelion is that which is nearest to it: and when the sun is in Apogee the earth is in Perihelion; when the sun is in Perigee the earth is in Aphelion.

These two points are subject to a slow annual motion *in consequentia*, or eastward, referred to the mean equinoctial point; (i. e. according to the order of the signs;) the mean rate of which we assume at 11″·66[e]: and this being compounded with the mean annual rate of the Precession in the contrary direction or *in antecedentia*, the mean annual rate of the change of the place of the solar apogee or solar perigee, relatively to the point of the mean vernal equinox, i. e. the mean annual increment in the longitude of either, reckoned from the mean vernal equinox perpetually, is 61″·729 541.

Mean annual Precession	50″·069 541
Mean annual proper motion of the Apogee ..	11 ·66
	61″·729 541

The noctidiurnal increment, obtained from this annual one, in the manner already explained[f], is 0″·169 009 858 5:

[e] Tables and Formulæ, p. 17. 104. Cf. 270. [f] P. 199.

the mean horary is 0″·007 042 077 437 5. On these data Tables v and vi have been constructed.

It appears indeed to be considered doubtful whether the proper annual motion of the apsides should be assumed at 11″·66 (as proposed by La Place), or at some other value, greater or less than that; for instance 11″·8[g]: and this is a point on which we offer no opinion of our own. We will observe only that, if we may assume the line of the apsides to have coincided critically with the line of the equinoxes A. M. 1 B. C. 4004, and consequently the mean longitude of the apogee (A L) at that moment to have been 0° 0′ 0″[h]; then the mean motion of the apsides, referred to the mean vernal equinox perpetually, and brought down to the present day according to the annual rate of the increment assumed in this Table, will be found to be remarkably in agreement with the truth, as determined by the most accurate modern observations. Let us compare the mean longitude of the solar apogee, AL, according to our Table, at mean noon Jan. 1 New Style for the meridian of Greenwich, A. D. 1801, with that which is assigned it, after Bessel, in the Tables and Formulæ of the late Mr. Baily.

i.—*From the Mean V. E. A. M.* 1 *B. C.* 4004 *to the Mean V. E. A. M.* 5805 *A. D.* 1801 = 5804 *years.*

TABLE V. PART i.

		°	′	″
5000 years	=	85	44	7·705
800 —	=	13	43	3·6328
4 —	=		4	6·918164
5804 years	=	99	31	18·255964

			h.	m.	s.
ii.—A. D. 1801 we have M. V. E. of the Tables, ..	..	March 9.	0	16	12
Correction ..	..	+ 2.	0	11	9·6
True M. V. E. at Jerusalem	..	March 11.	0	27	21·6
		—	2	20	47
At Greenwich	..	March 10.	22	6	34·6
	=	March 22.	22	6	34·6
		— 80	10		
		Jan. 1.	12	0	·0

g Tables and Formulæ, loc cit.
h See our Fasti, ii. 130–137. Diss. ix. ch. vi.

			°	′	″
iii.—M. V. E. meridian of Greenwich,		A L =	99	31	18·255964
— 80 d. 10 h. Table v. Part ii.				−	13·591
Jan. 1 mean noon	..	A L =	99	31	4·664964
According to Bessel[i].	..	..	99	31	9·91
				−	5·245036

That is, the difference between our Table and Bessel after the lapse of 5804 years was not more than 5″·245, or scarcely at the rate of 1″ in a thousand years. We think then that the assumptions on which we have proceeded in the construction of this Table must have been agreeable to the truth.

The line of the apsides having coincided with the line of the equinoxes at the beginning of the present system of things; in the course of time it would coincide with the line of the solstices. Astronomers are not more agreed as to the precise date of this latter coincidence, according to their own calculations and their own formulæ, than as to that of the former; and they have determined it variously from A. D. 1245 to A. D. 1250[k]. According to our own Table it is determinable to the winter solstice A. D. 1245.

A. M. 1 *B. C.* 4004 *M. V. E. to A. M.* 5249 *A. D.* 1245
M. V. E.=5248 *mean tropical years.*

TABLE V. PART i.

			°	′	″	
	5000 years	=	85	44	7·705	
	200 —	=	3	25	45·9082	
	40 —	=		41	9·18164	
	8 —	=		8	13·836328	
AL	5248 years	=	89	59	16·631168	M. V. E. A. D. 1245
Table v. Pt. ii.	273 d. 22 h. 20 m.	=		+	46·297	
	A L	=	90	0	2·928168	M. W. S.
	P L	=	270	0	2·928168	

Longitude of the apogee and perigee, at the mean winter solstice, A. D. 1245, for the meridian of Jerusalem.

The excess above 90° or 270° at this moment according to the Table is only 2″·928168: and with the mean motion of our solar Tables (Table viii. Pt. ii.) this corresponds to 1 m.

[i] Tables and Formulæ, p. 270. [k] See p. 203.

11·3 sec. of mean solar time. When the mean longitude of the apogee is 90°, and that of the perigee 270°, exactly, the precession of the mean anomalistic year over the mean tropical should be equal to one quarter of the latter year exactly. But in the present instance, and with the mean time and mean motion of our own Tables, there should be an excess of 1 m. 11·3 sec. exactly over one quarter of the natural year of our standard. And it is easy to put this to the test by means of our Tables of Precession, of which we shall give an account by and by.

SUPPLEMENTARY TABLES.—TABLE XXXVI.

	d.	h.	m.	s.
5000 years =	86	23	36	52·152 324 211
200 =	3	11	30	16·486 092 968 44
40 =		16	42	3·297 218 593 688
8 =		3	20	24·659 443 718 737 6
M. V. E. A.D. 1245, 5248 years =	91	7	9	36·595 079 491 865 6
3 quarters of one year's precession			+ 18	47·311 822 848 631 65
M. W. Solstice	91	7	28	23·906 902 340 497 25
One quarter of the tropical year	91	7	27	12·6
			+ 1	11·306 902

As nothing is more frequently required for calculations of various kinds than the sun's mean anomaly, this Table v, Part i and ii, is likely to be a very useful one, especially for chronological purposes which do not require an absolute astronomical exactness. We have found it ourselves one of the most serviceable of all our Tables.

With regard to Table vi, the mean length of the natural solar month is 30 d. 10 h. 29 m. 4 sec. 12 th. The actual month is commonly greater or less than this; greater when the sun is describing the last 30 degrees before the point of the apogee, or the first 30 degrees after it; less when it is doing the same before or after the point of the perigee. If the actual month ever approaches to an equality to the mean, it is when the sun is about half way between the apogee and the perigee, or between the perigee and the apogee; i. e. at or about one of the extremities of the axis minor of the solar orbit. We have calculated this Table, to enable the student in chronology to form at any time a ge-

neral idea of these distinctions, sufficiently near to the truth to answer the purpose of chronology. It shews the actual longitude of the apogee, (and this increased by 6 signs is that of the perigee also,) at the ingress of each of our Periods. For any intermediate point of time it may be assumed at sight from this, when it is only known that the longitude of the epoch increases by

°	′	″	
0	57	36·854	in the period of 56 years,
1	55	13·708	in that of 112,
2	24	2·136	in that of 140.

SECTION VI. Table vii. Part i.—*Mean motion of the Sun in longitude in mean solar days, from one day to* 365 *days.*

Part ii. *Mean motion of the Sun in longitude in mean solar hours, from one hour to* 24.

Part iii. *Mean motion of the Sun in longitude in mean solar minutes, from one minute to* 60.

Part iv. *Mean motion of the Sun in longitude in mean solar seconds, from one second to* 60; *and in decimal parts of mean solar seconds, from one to* 10.

Table viii. Part i. *Mean motion of the Sun in degrees and signs, reduced to mean solar time.*

Part ii. *Mean motion of the Sun in minutes, seconds, and decimal parts of seconds, of a degree, reduced to mean solar time.*

The mean length of the tropical year being assumed at 365·24225 days, and 360° being divided by 365·24225, the quotient, when carried out sufficiently far, is found to be

$$0°{\cdot}985\,647\,197\,168\,454\,6$$
i. e. $0°\ 59'{\cdot}138\,831\,830\,107\,276$
or $0°\ 59'\ 8''{\cdot}329\,909\,806\,436\,56$

The mean diurnal motion of the sun in longitude, corresponding to an angular motion of 360° in 365·24225 days, is therefore this quantity. The mean horary motion deducible from it is

$$2'{\cdot}464\,117\,992\,921\,136\,5.$$

The mean sexagesimal motion in minutes is

$$0'{\cdot}041\,068\,633\,215\,352\,275.$$

In mean solar seconds it is

$$0'{\cdot}000\,684\,477\,220\,255\,871\,25;$$

And in decimal parts of a second it is

0″·000 068 447 722 025 587 125.

From these data we have compiled Table vii, Parts i—iv: and though it will probably appear at first sight that we have carried each of these Tables much further in decimal parts than could ever be necessary for any practical use and purpose; we have done this advisedly: having laid it down as a principle that in all cases of this kind the higher elements of our Tables should be as nearly as possible recoverable from the lower; that 60 seconds' mean motion should represent that of one minute exactly; 60 minutes' mean motion that of one hour; and so on: in which case no part of these Tables could be dispensed with. The completeness of this representation in the preceding instances may be judged of from the result of all at last; viz. that though one day's mean motion, 59′·138 831 830 107 276 thus recovered, multiplied by 365·24225, will not give 360° exactly, it will give 359° 59′·999 999 999 999 227 611.

With regard to Table viii, Part i and ii; if 365·24225 days be divided by 360°, the quotient is 1 d. 014 561 805 555; i.e. in mean solar hours, 24 h · 349 483 333 32 = 1 d. 0 h. 20 m. ·968 999 999 2. We have therefore

An angular motion of 1° = 24 h · 349 483 333 32
An angular motion of 1′ = 24 m · 349 483 333 32
An angular motion of 1″ = 24 s · 349 483 333 32
An angular motion of 0″·1 = 2 s · 434 948 333 332

on which this Table has been constructed.

SECTION VII. Table ix.—*Mean motion of the Sun in longitude in the equable year, Cyclical or Nabonassarian, from one to 7000 equable years.*

Table x.—*Mean motion of the Sun in longitude in the mean Julian year, from one to 7000 mean Julian years.*

Had the primitive equable form of the civil year continued in use down to the present day; the solar and lunar Tables of the astronomers must still have been calculated for years of this description, as they formerly were. Nor has this primitive equable year even yet ceased to be somewhere or

other retained in use at the present day. We trust however no apology can be necessary for the introduction of a Table of this kind among the other Supplementary Tables of a work like ours, which has had so much to do with this particular form of the civil year.

Now the mean motion of the sun in longitude in one day being $59' \; 8''\cdot 329\,909\,806\,436\,56$; in 365 days it must be

$$359^\circ \; 45' \; 40''\cdot 417\,079\,349\,344\,4$$

On this datum a Table for any number of years of 365 days in length and no more perpetually might easily be constructed. We have limited this (as in fact every other of the same or a similar description) to 7000 years of its proper æra.

It has been seen[1] that the proper style of a Table of this kind intended to go back from the present day is the Nabonassarian rather than the Cyclical: and that the proper epoch of such a Table at first was Mesore 10=April 25, and at present is Mesore 9=April 24. We will illustrate and verify this distinction by means of the present Table, in the case of the last Nabonassarian and Cyclical year which enters our Tables; the former Nab. 2748—2749 the latter Æra Cyc. 6007—6008. Nab. 2749 enters our Tables on the first of Thoth at midnight along with April 10 at midnight (old style) A. M. 6004 A. D. 2000: and Mesore 9, 27 days before, on March 14 at midnight. Let us therefore first find the mean longitude of March 14 at mean noon A. M. 6004 A. D. 2000.

					h.	m.	s.
i.	A. D. 2000 Tab. V. E,	March	7	5	15	21·6
	Correction.	+	2	0	11	9·6
	True mean V. E. ..	March	9	5	26	31·2
		+	5	6	33	28·8
		March	14	12	0	0

			°	′	″				h.	m.	s.
ii.	SL.	=	0	0	0·0	March		9	5	26	31·2
	Table vii. P. i—iv.	+	5	11	51·230 697	=	+	5	6	33	28·8
	SL.	=	5	11	51·230 697	March		14	12		

1 Fasti, i. 635—643. Diss. viii. ch. ii. section viii: 643—649. section xi. xii.

iii.	Table ix. 6000 years	=	° ′ ″ 7 21 42·476 096 066 4
	7	=	358 19 42·919 555 445 410 8
	6007	=	5 41 25·395 651 511 810 8
	Subtract 1 day, Table vii, P. i.		− 59 8·329 909 806 436 56
			4 42 17·065 741 705 374 24
	Add 12 hours, Table vii, P. ii.		+ 29 34·164 954 903 218 28
	Mean longitude of Mesore 9 Æra. Cyc. 6008. ..		5 11 51·230 696 608 592 52

Entire revolutions or circumferences are here not taken into account. We see then from this example that mean longitude brought down in our Table from Æra Cyc. 0—1 to Æra Cyc. 6007—6008 Nab. 2748—2749, and mean longitude reckoned from the epoch of mean longitude, the mean vernal equinox, A. M. 1 B. C. 4004, to the mean vernal equinox A. M. 6004 A. D. 2000 perpetually, are the same thing; but that the proper epoch of the former at first was Mesore 10, and at present is Mesore 9. For we perceive that equable longitude at mean noon Æra Cyc. 6007—6008 (mean solar longitude brought down in the equable period of 365 days perpetually) is one day's mean motion greater than mean longitude, brought down in the mean tropical year from the first year of that description to the 6007th, and to the sixth day of that year at mean noon, March 14 A. M. 6004 A. D. 2000. This one day is the difference of Mesore 10 and Mesore 9; i. e. of the equable epoch *de facto* Æra Cyc. 0—1 and the same epoch *de facto* Æra Cyc. 6007—6008. And yet it has been shewn[m] that the feria of the equable epoch Æra Cyc. 0–1 is represented by that of Mesore 9, not by that of Mesore 10, Æra Cyc. 6007—6008. It is clear then that the equable epoch between Æra Cyc. 0—1 and Æra Cyc. 6007—6008, continuing nominally all the while the same, must in reality have undergone a change: i. e. must have dropped from the proper term in its own notation on which it set out (Mesore 10) to the next below it (Mesore 9.)

The same example however proves also that, as the original epoch was Mesore 10, so it may be considered nominally to be Mesore 10 still. The mean longitude of Æra Cyc. 6007—6008 at mean noon was that of Mesore 10 at mean noon;

m Supra, page 137.

only as corresponding not to March 14 at mean noon, but to March 15. On this assumption the epoch of this Table, referred to Æra Cyc. 5808—5809 Nab. 2549–2550, A. M. 5805 A. D. 1801, will be that of Mesore 10 at mean midnight or at mean noon: and as Thoth 1 Nab. 2550 entered the Tables May 30 at midnight A. D. 1801, Mesore 10 did so May 4 at midnight. The mean longitude of Mesore 10 Æra Cyc. 5808—5809 Nab. 2549—2550 was consequently that of May 4 A. M. 5805 A. D. 1801. We may verify this as follows.

			h.	m.	s.
i. Mean V. E. A. D. 1801. supra[n]	March 11		0	27	21·6
		+	54	11	32 38·4
	May 4		12	0	0

			°	′	″		h.	m.	s.
ii.	S L	=	0	0	0·0	March 11	0	27	21·6
Table vii, Part i–iv		+	53	41	56·561 816	+ 54	11	32	38·4
	S L	=	53	41	56·561 816	May 4	12		

iii. Table ix.

		°	′	″
5000 years	=	246	8	5·396 746 722
800	=	168	58	53·663 479 475 52
8	=	358	5	23·336 634 794 755 2
5808 years	=	53	12	22·396 860 992 275 2
Add 12 hours, Table vii, P. ii		+	29	34·164 954 903 218 28
S L Mesore 10 Æra Cyc. 5808, Nab. 2549		53	41	56·561 815 895 493 48

For any other meridian, like that of Greenwich, west of Jerusalem, this longitude must be increased by 2 h. 20 m. 47 s. mean motion, from Table vii P. ii–iv: i. e. by

5′ 46″· 906 744 770 080 666 925.

In coming down with an equable Table of this kind from the first, it is most convenient to treat its epoch as Mesore 10 in the Nabonassarian style perpetually; but as Mesore 10 in that style, down to Period xxxv, constantly equated to the corresponding cyclical term: which in the first instance, Period i Æra Cyc. 0–1, was Thoth 1 = April 25 at midnight; and Period xxxv Æra Cyc. 4231–4232 Nab. 972–973, is Mesore 2, = June 2 A. D. 225[o]. Thus at the ingress of Period xxv A. M. 3025 B. C. 980 Mesore 10 in the Nabonassarian style was

[n] Page 208. [o] See our Fasti, i. 610–673. Diss. viii.

corresponding to Mesore 12 in the Cyclical, Æra Cyc. 3026–3027, and both to March 30 at midnight. The mean longitude therefore of Mesore 10 at midnight or at noon, Æra Cyc. 3026–3027, according to Table ix, should be that of March 30 at midnight or at noon also, A. M. 3025 B. C. 980. And that this was the case, may thus be shewn:

			h.	m.	s.
i. B. C. 980, Tabular M. V. E.		April 1	1	21	0
Correction	..	+	12	11	9·6
True M. V. E.	..	April 1	13	32	9·6
		− 2	1	32	9·6
		March 30	12		

		°	′	″		h.	m.	s.
ii. S L	=	0	0	0·0	April 1	13	32	9·6
Table vii, P. i–iv	−	2	2	3·75292	− 2	1	32	9·6
S L		357	57	56·24708	March 30	12		

iii. Table ix.

		°	′	″	
3000 years	=	3	40	51·238 048	
20	=	355	13	28·341 587	
6	=	358	34	2·502 476	
3026	=	357	28	22·082 111	= mean longitude of Mesore 10 Æra Cyc. 3026–3027 at midnt.
Add 12 h.	=		29	34·164 955	
		357	57	56·247 066	mean longitude of Mesore 10 at mean noon.

With regard to Table x, we have

		°	′	″
Table ix, 365 days	=	359	45	40·417 079 349 344 4
Table vii, Part ii, 6 h.	=	+	14	47·082 477 451 609 14
365 d. 6 h.	=	360	0	27·499 556 800 953 54

The increment therefore, or addition annually made to the mean longitude of the sun, reckoned perpetually from any epoch soever, in the mean Julian year of 365 days six hours, must be this quantity over and above one entire circumference,

$$0^\circ\ 0'\ 27''\cdot 499\ 556\ 800\ 953\ 54.$$

On this datum our xth Table has been constructed.

In 100 mean Julian years, 36525 mean solar days and nights, this constant annual increment in the mean longitude of the epoch over and above 100 circumferences is found to be

$$0^\circ\ 45'\ 49''\cdot 955\ 680\ 095\ 354.$$

It does not appear that the mean secular movement in longitude, exclusive of entire revolutions, has ever been assumed by astronomers at any amount materially different from this. Mr. Baily has given the following from various authorities [p]:

	°	′	″
La Lande	0	46	0·0
Baron Zach	0	45	48·0
Delambre	0	45	54·0
and	0	45	45·0
Damoiseau	0	45	53·0
Our own is	0	45	49·956
or	0	45	50

He tells us that Delambre assumed it at first at 0° 45′ 54″, and afterwards at 0° 45′ 45″; declaring however that he thought this latter too little. The secular increment which results from our own Table is almost a mean between these two expressions of Delambre for the same thing. It is evident therefore that the mean secular movement in longitude of our own solar Tables is such as the astronomers themselves must admit to be perfectly probable and allowable.

It may perhaps be objected to this Julian Table that it is superfluous; especially on the assumption that the true epoch of mean solar longitude, whether downwards from B. C. 4004 or upwards from A. D. 1801, is the Solar Cycle of our own Tables; for that being the case, there is no safer nor more expeditious mode of finding the mean solar longitude on any day and at any time of any day in any year, than by calculating from the mean vernal ingress in division B of our General Tables: in which case we should make use of Table vii and its several parts indeed perpetually, but we should have no occasion for Table x. And it must be confessed that, in all our own calculations of this kind, this is the course in which we have uniformly proceeded; so that in point of fact we have made no use of this tenth Table in particular.

But to say nothing of the deference due to the authority and example of astronomers generally, whose solar tables are all adapted to the mean Julian year; a table of this kind serves a very important purpose of another description, which

p Tables and Formulæ, P. 1.

is sufficient to justify its introduction among the rest of our Supplementary Tables. This Table is a standing witness of the true decursus of annual mundane time in terms of the mean solar longitude. It ought not to be forgotten that the proper Julian epoch of this table, (April 25 or April 24, ever after,) at the beginning of things was the epoch of mean longitude also. The mean annual Julian time of our Tables and the mean annual natural time, for the proper meridian, (the primary meridian, the meridian of the ancient Jerusalem[q],) both began together at midnight A. M. 1 B. C. 4004: the consequence of which fact would be that by virtue of the law of precession, and by virtue of the inequality of the mean natural annual time of our Tables to the mean annual Julian, the mean longitude of the mean Julian epoch though setting out at par with the mean natural one, and both from the point of zero or $0^\circ\ 0'\ 0''$, must go on increasing in comparison of that at the rate of $27''\cdot 499\ 556\ 800\ 953\ 54$ every mean Julian year: for this is the arc which with the mean motion of our Tables measures the difference of the mean Julian and the mean tropical year of our standard, 11 m. 9.6 s. perpetually.

It follows that, this being an annual increment yet a constant and invariable one, the sum total of the increment at a given time must be exactly proportional to the number of years in which it has been accumulated; that the sum total of the increment, if known at a particular time, divided by the number of years in which it has been accumulating, if known also, must give the mean annual rate of the increment; and *vice versa*, the sum total of the increment up to a given time, divided by the annual rate of the increment, must give the number of years in which it has been accumulated. It must therefore be true to say that the mean longitude of this Julian term, (April 25 at first, April 24 at present,) at a given time is a standing test and criterion of the age of the world itself up to that point of time; of that world which began at the Mosaic creation, and with which human existence in particular has always been connected. Consequently the importance and utility of a Table, calculated to serve such a purpose as this, is or ought to be undeniable

[q] See the Fasti, ii. 58–67. Diss. ix. ch. iii.

also. The astronomer who desires to meet with a plain and convincing, as well as a standing and perpetual, testimony to the truth of the Scriptural chronology of the present system of things, from the very beginning down to the present day, and a testimony derivable from his own science, has nothing to do but to calculate the mean longitude of this Julian term April 25, at mean noon or at midnight, for any meridian which he pleases, and as exactly as he can; and he will find in that the evidence of which he is in search. And though no mean longitude, but that of this Julian Table, divided by the annual increment corresponding to it will give the true age of the world in exact conformity to the Scriptural account thereof; yet no observed or assumed longitude, nor any measure of the annual increment which could be applied to it, will give it in a manner materially different from our own, or incapable of being easily reconciled to it.

With regard to the epoch of this Table; it is first and properly adapted to the meridian of Jerusalem, and first and properly to the point of mean midnight for that meridian. The tables of the astronomers heretofore have been generally adapted to the epoch of mean noon; but as the civil day every where among Christians at least begins at midnight, it has been proposed by the astronomers themselves that they should adopt the same rule too. Accordingly the Tables which are published in France, under the sanction of the Bureau des Longitudes, have already begun to be adapted to this new epoch of midnight; and though no such change has yet been made in the tables published by authority in this country, it is not improbable that it will be sooner or later: in which case the astronomical rule will only fall in with the rule of our Tables, and (as we may add) with the matter of fact itself from the first. For both mean Julian time and mean Julian longitude, such as we exhibit in this tenth Table in conjunction perpetually, *de facto* began at midnight, and therefore must be supposed ever after to be referred to the epoch of midnight.

We have thought it best however, at present and under existing circumstances, to accommodate this Table to the epoch of mean noon as well as to that of mean midnight. For its proper meridian therefore, and in coming down from

A. M. 1 B. C. 4004 perpetually, the mean longitude of the epoch, at mean midnight April 25, is 0° 0′ 0″; at mean noon is 12 hours' mean motion from Table vii Part ii greater,

$$\begin{array}{l} \circ \quad \prime \\ 0 \quad 29{\cdot}569\,415\,915\,053\,638 \\ 0 \quad 29'{\cdot}\,34''{\cdot}\,164\,954\,903\,218\,280 \end{array}$$

With respect to any other meridian, it has been shewn elsewhere[r] that, if the local time of the primary meridian began to be reckoned from midnight, the local time of every other meridian west of the primary one would begin to be reckoned from midnight also, but as much later in the local time of the primary meridian as was in proportion to the difference of meridians. Under these circumstances, though there would be a proper measure of duration by the same period of 24 hours in the local time of every other meridian, reckoned from the point of midnight for each perpetually, the absolute measure of duration by this period, reckoned from a given instant of time and that the point of midnight, must be in the local time of the primary meridian perpetually. The same distinction holds good of mean longitude. The mean longitude of the primary meridian, referred to its proper epoch perpetually, is the only absolute measure of the increment of mean longitude through the entire cycle of meridians distinct from itself. The mean longitude of any other meridian, either west or east of this, at a given time, is the mean longitude of the primary meridian at the same absolute instant of duration in its proper or local time. The meridian of Greenwich is west of that of Jerusalem, and 2 h. 20 m. 47 s. west of that. Mean midnight or mean noon therefore in the local time of Greenwich is 2 h. 20 m. 47 s. after or past mean midnight or mean noon in the local time of Jerusalem. Mean longitude therefore at mean midnight for the meridian of Greenwich is mean longitude at 2 h. 20 m. 47 s. past mean midnight for the meridian of Jerusalem; i. e. the mean longitude of the primary meridian at mean midnight in its local time, increased by 2 h. 20 m. 47 s. mean motion, is the mean longitude of any other meridian just 2 h. 20 m. 47 s. west of the primary one, (like the meridian of Greenwich,) at mean midnight in the local time of this meridian also.

[r] Fasti, ii. 65. Diss. ix. ch. iii. sect. iv.

Now 2 h. 20 m. 47 s. with the mean motion of our Tables (Table vii Part iv) = 5′ 46″· 906 744 770 080 666 925. We have therefore, A. M. 1 B. C. 4004,

	° ′ ″	
i. Longitude of the epoch, or S L =	0 0 0	April 25 at midnight, meridian of Jerusalem.
	+ 5 46·906 744 770 080 666 925	
S L =	0 5 46·906 745	April 25 at midnight, meridian of Greenwich.

		° ′ ″	
ii. S L	=	0 29 34·164 955	April 25 mean noon, meridian of Jerusalem.
		+ 5 46·906 745	
S L	=	0 35 21·071 700	April 25 mean noon, meridian of Greenwich.

It is very desirable that a Julian Table like this should be provided with a fourfold epoch, one for each year of the cycle of leap-year. This desideratum is easily supplied by adding to these epochs, for either meridian, 365 days' mean motion (Table vii P. i) in the common years of the cycle, and 366 in the leap-year, which in this first instance of all comes in A. M. 3–4 B. C. 4002–4001.

With regard to the epoch of a Table of this kind, designed to go back from the present day perpetually; we assume that it is as properly the mean longitude of April 24 in going back from the present day to the beginning of things, (and the mean longitude of April 24 reckoned from the point of the mean vernal equinox,) as that of April 25 similarly reckoned in coming down from the beginning. And yet the actual mean longitude of April 24, reckoned from the mean vernal equinox, at present is one day's mean motion less than that of April 25 brought down from the first in this Table; as may thus be shewn.

		h. m. s.
i. A. D. 1801, M. V. E.[s]	March 11	0 27 21·6
	+ 44	23 32 38·4
	April 25	0 0 0·0

		° ′ ″		h. m. s.
ii. S L	=	0 0 0	March 11	0 27 21·6
Table vii, P. i–iv		+ 44 20 7·427 673	+ 44	23 32 38·4
S L	=	44 20 7·427 673	April 25	0 0 0

[s] P. 208.

iii. Table x.

		°	′	″
5000 years	=	38	11	37·784 004 767 7
800	=	6	6	39·645 440 762 832
4	=		1	49·998 227 203 814 16
5804 years	=	44	20	7·427 672 734 346 16

It is manifest therefore from this calculation that the mean longitude of the epoch, brought down 5804 years of its proper æra, must have been 44° 20′ 7″·427 673 at the point of midnight: and it is equally evident that 44° 20′ 7″·427 673 *de facto* is the mean longitude of April 25 at midnight reckoned from the point of the mean vernal equinox A. M. 5805 A. D. 1801. If so the mean longitude of April 24 at midnight the same year must have been one day's mean motion less than this: and consequently less than the mean longitude of the epoch brought down 5804 years.

This distinction in the present instance is absolutely identical with that which we pointed out supra [t], in the case of Mesore 10 and Mesore 9; and the explanation of the one is the same as that of the other: viz. that though April 25 may nominally continue the same as ever, and its nominal relation to the mean vernal equinox may continue the same too, it is in reality an higher term in the actual Julian notation of such terms at present than April 25 was at first, and than April 25 would have been at present, if nothing had happened meanwhile to affect its real without changing its nominal value. The test of this distinction is the place of April 25 at present in the order of feriæ, compared with its place in the same order at first. We shewed on a former occasion [v] that the feria of origination, represented by Mesore 10 Æra cyc. 0–1, was represented *de facto* by Mesore 9 Æra cyc. 5808–5809; not by Mesore 10. It may be proved by just the same kind of reasoning that the feria of origination, represented by April 25 A. M. 1 B. C. 4004, was represented by April 24 A. M. 5805 A. D. 1801, not by April 25; from which it will follow that for some reason or other, between A. M. 1 and A. M. 5805, April 24 as the Julian epoch of origination must have stepped into the place of April 25, and ever since have represented its real value in that particular capacity of the Julian epoch of origination: though not its name.

[t] Page 209. [v] Page 137.

In 5804 mean Julian years the hebdomadal epact must amount to 5804 days + the number of leap-years in 5804 mean Julian years; i. e. 1451. Consequently the sum of this epact in 5804 such years must be $5804+1451=7255=$ 1036 cycles of seven, and three feriæ over. If then the feria of origination in the order of the hebdomadal cycle at the beginning of the first of these years was the feria prima, the proper representative of that feria in the same order at the beginning of the 5805th of these years must be the feria quarta. Now A. M. 1 B. C. 4004, Dom. Letter C, April 25 was the feria prima; which is agreeable to our hypothesis: A. M. 5805 A. D. 1801, Dom. Letter F, April 25 was the feria quinta: April 24 was the feria quarta. The former is not consistent with the actual succession of one and the same thing (the feria of origination) in an actual order of that kind which has never varied, the order of the hebdomadal cycle. The latter is so, if April 24 in the order of Julian terms applied to the order of feriæ perpetually was as truly the proper Julian exponent of the feria prima A. M. 1, as of the feria quarta A. M. 5805.

It is manifest however that, if we looked only at the nominal order and succession of Julian terms, without paying any regard to the order of feriæ with which they must have been associated from the first; April 25 would be as competent to represent the Julian epoch of origination still as ever: and the mean longitude of April 25 at mean midnight or mean noon, reckoned from the mean vernal equinox at present, would represent in terms the mean longitude of this Table brought down to the same point of time from the first. We might therefore have retained April 25 for the use of this Table, with just as much reason as Mesore 10 for that of the ninth[x]. We have preferred however in this instance to substitute the true Julian term of that description at present, April 24 old style = May 6 new style. But it must be evident in any case that as April 24 and April 25 both stand in the same relation to the mean vernal equinox A. M. 5805 A. D. 1801, mean longitude carried back from either is virtually the same as mean longitude carried back from the other.

x Page 209.

We have therefore, A. D. 1801,

	° ′ ″	
i. Meridian of Jerusalem, Longitude of the epoch, or S L =	44 20 7·427 672 734 346 16	April 25 mid.
Subtract one day ..	− 59 8·329 909 806 436 56	
S L =	43 20 59·097 762 927 909 60	April 24 mid.
	+ 5 46·906 744 770 080 666 925	
At Greenwich, S L =	43 26 46·004 507 697 990 266 925	April 24 mid.

	° ′ ″	
ii. Meridian of Jerusalem, S L =	43 20 59·097 762 927 909 6	April 24 mid.
Add 12 h. = ..	+ 29 34·164 954 903 218 28	+ 0·12
S L =	43 50 33·262 717 831 127 88	April 24. 12.
	+ 5 46·906 744 770 080 666 925	
At Greenwich, S L =	43 56 20·169 462 601 208 546 925	

And from these it is easy to obtain the epochs of the rest of the years of one cycle of leap-year, A. D. 1801 inclusive to A. D. 1804 inclusive: and for either meridian.

Comparison of Table ix *and Table* x.

5844 equable years = 5840 mean Julian.

Table ix. Years.	°	′	″	Table x. Years.	°	′	″
5000 =	246	8	5·396 746 722	5000 =	38	11	37·784 004 767 7
800 =	168	58	53·663 479 475 52	800 =	6	6	39·645 440 762 832
40 =	350	26	56·683 173 973 776	40 =		18	19·982 272 038 141 6
4 =	359	2	41·668 317 397 377 6				
5844 =	44	36	37·411 717 568 673 6	5840 =	44	36	37·411 717 568 673 6

Section VIII. Table xi. Part i.—*Mean motion of the Moon in longitude in mean solar days, from one day to* 365 *days.*

Part ii.—*Mean motion of the Moon in longitude in mean solar hours, from one hour to* 24.

Part iii.—*Mean motion of the Moon in longitude in mean solar minutes, from one minute to* 60.

Part iv.—*Mean motion of the Moon in longitude in mean solar seconds, from one second to* 60; *and in decimal parts of a second, from one to* 10.

Table xii. Part i.—*Mean motion of the Moon in degrees, reduced to mean solar time, from one degree to* 360.

Part ii.—*Mean motion of the Moon in minutes, and seconds, and decimal parts of seconds, of a degree, reduced to mean solar time.*

Table xiii.—*Mean motion of the Moon in longitude in the equable year, Cyclical or Nabonassarian, from one to 7000 equable years.*

Table xiv.—*Mean motion of the Moon in longitude in the mean Julian year, from one to 7000 mean Julian years.*

The data required for these Tables have been either taken or obtained from the Tables and Formulæ of the late F. Baily, esq.[y]; adapted, as there represented, to mean noon Jan. 1 (N. S.) A. D. 1801, for the meridian of Greenwich.

Mean diurnal motion of the moon in longitude	13°·176 396 39
	13° 10′·583 783 4
	13° 10′ 35″·027 004
Mean horary motion	0° 32′·940 990 975
Mean sexagesimal, in minutes	0° 0′·549 016 516 25
Mean sexagesimal, in seconds	0° 0′·009 150 275 270 8
In decimal parts of a second	0° 0′·000 915 027 527 08

Mean angular motion of the moon, of one day, or 13°·176 396 39	=	24 h · 0
— — of 1° ..	=	1 h · 821 438 828 162
	or	1 h. 49 m · 286 329 689 72
	or	1 h. 49 m. 17 s · 179 781 383 2
— — of 1′ ..	=	1 m. 49 s · 286 329 689 72
— — of 1″ ..	=	1 s. 49 th · 286 329 689 72
	or	1 s · 821 438 828 162
— — of 0″·1 ..	=	0 s · 182 143 882 816 2

	Rev.	°	′	″
Mean motion in 365 mean solar days =	13	129	23	4·856 46
Mean motion in 365 days 6 hours =	13	132	40	43·613 211
Mean motion in 36525 mean solar days, 100 mean Julian years =	1336	307	52	41·321 10

The epoch of the xivth Table among the above is April 29 at mean noon, for the meridian of Greenwich, A. D. 1801: an epoch on which we fixed under an impression that April 29 was the true Julian epoch of lunar time in constant connection with the present system of things. And though we have seen reason to change this opinion, and to look on that epoch

y Page 44.

as more truly to be represented perpetually by April 28, we have not thought proper to correct the epoch of this Table. It is indifferent in itself what term is fixed on, to serve as the epoch of a table like this; provided its lunar characters are properly ascertained in the first instance and continue ever after the same.

Now April 29 Old style corresponding to May 11 New style, and the number of days from Jan. 1 mean noon (N. S.) to May 11 mean noon being 130; we take out of Table xi Part i 130 days' mean motion, and add it to the mean longitude of the epoch, Jan. 1 mean noon, A. D. 1801.

	°	′	″
M L, or mean longitude of the moon, Jan. 1 mean noon[z]	118	17	8·3
130 days' mean motion	272	55	53·51052
M L, May 11 = April 29, mean noon	31	13	1·81052

And from this a cycle of epochs for the first cycle of leap-year, A. D. 1801–1804, is easily obtained, by adding 365 days' mean motion to it in the common years, and 366 in the leap-year, A. D. 1803–1804.

We have not provided this Table with any epoch for the meridian of Jerusalem. The object for which all these Tables have been compiled being merely to facilitate the calculation of new or full moons for chronological purposes; the most convenient mode of applying them is to calculate first for the meridian of Greenwich: and then to reduce the calculation to any other meridian in the usual manner. Of the accuracy of the calculations thus made we hope to produce examples by and by. As the mean longitude of our Tables however, and the mean lunar momenta of every kind, of which we have made use in compiling them, are those of A. D. 1801, they require a secular correction to adapt them to those of any prior or any posterior epoch. The formula for the secular correction of the mean motion of the moon in longitude (M L) of which we have made use is that of the Baron Damoiseau,

$$+\ (10''\cdot 7232\,\kappa^2 \mp 0''.019\,361\,\kappa^3)\ ^{a}$$

in which κ stands for the number of centuries before or after the epoch, April 29 m. n. A. D. 1801 Old style. And in the application of this formula the rule is to subtract the term

[z] Tables and Formulæ, 44.
[a] Pontécoulant, Précis d'Astronomie, ii. 569. Tables and Formulæ, 47.

which contains κ^3 from that which contains κ^2, in calculating back from this epoch; to add the former to the latter in calculating forward from it: and then to apply the difference in the former case, the sum in the latter, with a positive sign, to the mean longitude (M L) found from this Table at the distance of κ centuries in question.

With regard to Table xiii, we assume its proper epoch at present to be the Nabonassarian Mesore 10 Æra Cyc. 2808—2809 Nab. 2549—2550, at mean noon, in this instance as much as in the former of Table ix. The Julian date of this day was May 4 at mean noon, A. D. 1801: and that being 5 days later than April 29, the mean longitude of the epoch of this Table is 5 days' mean motion greater than that of the epoch of Table xiv.

		°	′	″			
M L. Table xiv,		31	13	1·810 52	Apr.	29. 12	
Table x. P. i.	+	65	52	55·135 02	+	5.	
M L.		97	5	56·945 54	May	4. 12	=Mesore 10. m. n.

We apprehend that the same formula is competent to serve for the secular correction of the mean longitude of this Table as for that of Table xiv; though astronomers would doubtless make some slight alteration in it, before they applied it to the secular period of 100 equable years as much as to that of 100 mean Julian years.

Comparison of Table xiii *and Table* xiv.

5844 equable years = 5840 mean Julian.

Table xiii.	Rev.	°	′	″	Table xiv.	Rev.	°	′	″
5000=	66 797	3	24	42·30	5000=	66 842	273	54	26·055
800=	10 687	187	44	45·168	800=	10 694	303	1	30·568 8
40=	534	135	23	14·258 4	40=	534	267	9	4·528 44
4=	53	157	32	19·425 84					
5844=	78 072	124	5	1·152 24	5840=	78,072	124	5	1·152 24

Section IX. Table xv. Part i.—*Mean motion of the Lunar Perigee in mean solar days, from one day to* 365.

Part ii.—*Mean motion of the Lunar Perigee in mean solar hours, from one hour to* 24.

Part iii.—*Mean motion of the Lunar Perigee in mean solar minutes, from one minute to* 60.

Part iv.—*Mean motion of the Lunar Perigee in mean solar seconds, from one second to* 60.

Table xvi.—*Mean motion of the Lunar Perigee in the equable year, Cyclical or Nabonassarian, from one to* 7000 *equable years.*

Table xvii.—*Mean motion of the Lunar Perigee in the mean Julian year, from one to* 7000 *mean Julian years.*

The data for these Tables also are taken or obtained from the same quarter as those of the preceding[b].

	°	′	″
Mean diurnal motion of the Lunar Perigee,	0	6	41·055 894
Mean horary motion, ...	0	0	16·710 662 25
Mean sexagesimal, in minutes	0	0	0·278 511 037 5
Mean sexagesimal, in seconds ..	0	0	0·004 641 850 625
Mean motion in 365 mean solar days ..	40	39	45·402 034 5
Mean motion in 365 days six hours, ..	40	41	25·666 008

The mean longitude of the Lunar Perigee (P L) Jan. 1 mean noon, (N S.) A. D. 1801, for the meridian of Greenwich[c] was 266° 10′ 7″.5. Hence A. D. 1801,

		°	′	″	
P L	=	266	10	7·5	Jan. 1. mean noon.
Table xv. P. i.		+ 14	28	57·266 22	+ 130.
P L.	=	280	39	4·766 22	May 11. mean noon.
					= Apr. 29. mean noon.

The epoch for each of the remaining years of a complete cycle of leap-year is easily to be obtained from this.

The secular correction required by Table xvii in this instance also is supplied by the formula

$$-(39''\cdot 697\,1\,\kappa^2 \mp 0''\cdot 071\,674\,\kappa^3)^{\text{d}}$$

in which κ stands for the number of centuries from the epoch, April 29 m. n. A. D. 1801, before or after. And the rule is to subtract the term containing κ^3 from that which contains κ^2, in going back from the epoch; to add it to it, in going forward from it: and in each case to apply the difference before A. D. 1801, the sum after it, to the mean longitude (P L) found from this Table at the distance of κ centuries, with a negative sign.

b Tables and Formulæ, p. 45.
c Tables and Formulæ, 45.
d Pontécoulant, Précis, ii. 569. Tables and Formulæ, 47.

The epoch of Table xvi, the Nabonassarian Mesore 10 Æra Cyc. 5808—5809 Nab. 2549—2550, May 4 A. D. 1801, is 5 days later than that of April 29.

		°	′	″		
Hence, A. D. 1801,	P L =	280	39	4·766 22	April 29 m. n.	
Table xv. P. i.		+	33	25·279 47	+ 5	
	P L =	281	12	30·045 69	May 4	= Mesore 10. m. n.

Comparison of Table xvi *and Table* xvii.

5844 Equable years = 5840 Julian.

TABLE xvi.

Years.	Rev.	°	′	″
5000 =	564	273	3	30·172 5
800 =	90	130	5	21·627 6
40 =	4	186	30	16·081 38
4 =		162	39	1·608 138
5844 =	660	32	18	9·489 616

TABLE xvii.

Years.	Rev.	°	′	″
5000 =	565	52	18	50·040
800 =	90	152	22	12·806 4
40 =	4	187	37	6·640 32
5840 =	660	32	18	9·486 72

SECTION X. Table xviii. Part i.—*Mean motion of the moon's Ascending Node in mean solar days, from one day to* 365.

Part ii.—*Mean motion of the moon's Ascending Node in mean solar hours, from one hour to* 24.

Part iii.—*Mean motion of the moon's Ascending Node in mean solar minutes, from one minute to* 60.

Part. iv.—*Mean motion of the moon's Ascending Node in mean solar seconds, from one second to* 60.

Table xix.—*Mean motion of the moon's Ascending Node in the equable year, Cyclical or Nabonassarian, from one to* 7000 *equable years.*

Table xx.—*Mean motion of the moon's Ascending Node in the mean Julian year, from one to* 7000 *mean Julian years.*

The elements of these Tables too are taken or obtained from the data supplied by the Tables and Formulæ of Mr. Baily[e].

	°	′	″
Mean diurnal motion of the Node ..	0	3	10·636 480 8
Mean horary motion	0	0	7·943 286 7
Mean sexagesimal, in minutes ..	0	0	0·132 386 445
Mean sexagesimal, in seconds ..	0	0	0·002 206 440 75
Mean motion in 365 mean solar days	19	19	42·315 879
Mean motion in 365 days 6 h. ..	19	20	29·974 999 2

[e] P. 46.

The mean longitude of the ascending Node (N L) Jan. 1 mean noon, A. D. 1801, for the meridian of Greenwich, was

		°	′	″	
		13	53	17·7 [f]	
Table xviii, P. i		−6	53	2·742 504	= 130 days.
N L	=	7	0	14·957 496	May 11 = April 29 m. n.

The motion of the Node on the ecliptic is retrograde, or contrary to the order of the signs. In going forward then from a given epoch with the mean motion of the Node (N L) we use the sign *minus*; in going backward we use that of *plus*. The formula for the secular correction in this instance also is that of the Baron Damoiseau,

$$-(6''\cdot5632\,\kappa^2 \mp 0''\cdot011\,850\,\kappa^3)^{g}$$

in which κ stands for the number of centuries. And the term containing κ^3 is to be *subtracted* from that which contains κ^2 in going back from the epoch, April 29 A. D. 1801; is to be *added* to it in going forward from the epoch: and then the difference in the former case, the sum in the latter, is to be applied to the longitude found from the Table, (N L,) with a *negative* sign.

With regard to the epoch of Table xix, we have

		°	′	″	
	N L =	7	0	14·957 496	April 29 m. n.
Table xviii, Pt. i.	−		15	53·182 404	+ 5
	N L =	6	44	21·775 092	May 4 = Mesore 10 m. n.

Comparison of Table xix *and Table* xx.

5844 equable years = 5840 mean Julian.

Table xix.

Years.		Rev.	°	′	″
5000	=	268	162	6	19·395
800	=	42	342	44	12·7032
40	=	2	53	8	12·635 16
4	=		77	18	49·263 516
5844	=	313	275	17	33·996 876

Table xx.

Years.		Rev.	°	′	″
5000	=	268	228	17	54·996
800	=	42	353	19	39·999 36
40	=	2	53	39	58·999 968
5840	=	313	275	17	33·995 328

Section XI. Table xxi. Part i.—*The Annual or First Equation of the mean to the true syzygy.*

Part ii. *Equation of the moon's mean Anomaly.*

Part iii. *The Second Equation of the mean to the true syzygy.*

[f] Tables and Formulæ, p. 46.
[g] Pontécoulant, Précis, ii. 569. Tables and Formulæ, 47.

Part iv. *The Third Equation of the mean to the true syzygy.*

Part v. *The Fourth Equation of the mean to the true syzygy.*

Part vi. *Equation of the sun's mean distance from the Node.*

Part vii. *Equation of the sun's centre, or the difference between his mean and his true place.*

Part viii and ix. *Equation of true or apparent time to mean, and* vice versa.

These Tables have been borrowed from Ferguson's Astronomy, edited and republished by David Brewster, LL.D. Edinburgh, A.D. 1811[h]. Their titles sufficiently declare the purpose for which they are intended; viz. to facilitate the calculation of new or of full moons; and, in certain cases, to judge of the limits of solar or lunar eclipses. But for any further explanation of them we refer to the work in question.

SECTION XII. Table xxii. Part i to xx.—*Lunar Cycle of the Fasti, Type i. In Hipparchean Periods of* 304 *mean Julian years, xvi Metonic Cycles,* 3760 *mean or calendar lunations.*

Table xxiii. Part i to xix.—*Lunar Cycle of the Fasti, Type ii. In the Hipparchean Period of* 304 *mean Julian years, xix Hekkaidekaëteric Cycles,* 3760 *mean or calendar lunations.*

Table xxiv. Part i.—*Decrement of the Epoch in the Period of* 304 *mean Julian years, from Period i to xx.*

Part ii.—*Recession of mean lunar time on Calendar or Cyclical in the Period of* 304 *mean Julian years, through every Cycle of* 19 *years or* 235 *lunations.*

Part iii.—*Recession of mean Lunar Time in the Hipparchean Period on the mean Cyclical Standard of the Period, through one Cycle of* 19 *years or* 235 *lunations.*

Table xxv.—*Sum of mean solar time in days and nights, and in aliquot parts of days and nights, in the mean lunar month of the Fasti, from one month to* 80,000.

These Tables may all be considered supplementary to division D of the Fasti Catholici, which comprehends our perpetual Lunar Cycle or Lunar Calendar. We have explained Tables xxii, xxiii, and xxiv Part i, in this Introduction al-

h See vol. i. p. 367–371: 376: 173. ch. xiii. § 229: 181. § 241.

ready[i]. With regard to Table xxiv Part ii, the recession of mean lunar time of the standard of our Fasti in the Hipparchean Period is one period of 24 hours of mean solar time exactly; and this is at the rate of 1 hour 30 minutes in one cycle of 19 years, of 3 hours in two cycles, and so on. Supposing therefore the primary Julian epoch of the entire succession of the mean lunar time of our Tables to have been N at midnight for the proper meridian; we have exhibited in this Table the gradual recession of the true mean lunar time of the Tables on this Julian epoch of the whole, from N−0 at midnight to N−1 at midnight, N−2 at midnight, and so on perpetually: through the successive cycles of one Period indeed only as a type of the whole, but after a manner which it is evident would be just the same in all.

The primary epoch or that of origination being assumed as N at 0 h. 0 m. 0 s. (April 29 for example at midnight,) at the beginning of the first Period and of the first cycle of the Period; it must be N−1 at 0 h. 0 m. 0 s. − 1 h. 30 m. (April 28 at 22 h. 30 m.) at the ingress of the second cycle; N−1 at 0 h. 0 m. 0 s.—6 h. (April 28 at 18 h.) at the ingress of the fifth; N−1 at 0 h. 0 m. 0 s.—12 h. (April 28 at 12 h.) at the ingress of the ninth; N−1 at 0 h. 0 m. 0 s.—18 h. (April 28 at 6 h.) at the ingress of the thirteenth; and so on. It is manifest too that, while the true mean lunar time of the Period is thus receding gradually from cycle to cycle, the calendar or Julian lunar time of the Period is continuing stationary, and attached to the same epoch as at first. Nor does it undergo any change in terms, until the end of the Period itself; when it is set back 24 hours all at once. We have had occasion to use this Table repeatedly in the former part of this Introduction; where we were illustrating the uses of our perpetual lunar calendar by examples or cases in point[k].

With respect to Part iii of this Table, it was not absolutely necessary; but it may have its use, as shewing at one glance the number of months complete, at the ingress of every fresh year (whether common or intercalary) in the cycle of 19 years. For any other purpose, this Table must presuppose the equal division of the entire number of days

[i] Part ii. ch. i. p. 95—102. [k] Part ii. ch. ii. p. 102 sqq.

and nights, which make up the period of 304 mean Julian years, among the 3760 lunations which enter it also: and that would be at the rate of 29 d. 12 h. 44 m. 25 sec · 531 914 9, or 29 d · 530 851 063 829 8, to each: for 29 d · 530 851 063 829 8 × 3760 = 111 036 days. Nor is this a supposition of the state of the case which was not once matter of fact. Such was the standard assumed by Calippus for the correction of the Metonie cycle[1]; and such was the standard adopted in all those lunar calendars of antiquity which were regulated by the Calippic correction. Such was the mean lunar standard of the ecclesiastical calendar of Christendom itself, down to the Gregorian correction.

Such a division of the Period however among its 3760 lunations having been made, this Table xxiv, Part iii, would shew the recession of the true mean lunar standard of the Period on this assumed standard; viz. at the rate of 22 sec. ·978 723 4 in one lunation; of 4 m. 35 s · 744 680 8 in twelve lunations, and of 4 m. 58 s · 723 404 2 in thirteen lunations. And though we have drawn it out only for one cycle of 19 years and 235 lunations; it would proceed in the same manner through the entire Period, and its 16 cycles, and 3760 lunations.

With respect to the xxvth Table, it shews the number of mean solar days and nights and their proportional parts contained in any number of mean lunar months of the standard of our Fasti, from 1 to 80,000. We have found it a very useful Table, and we hope it may prove so to others.

The sum total of mean lunar months comprehended in our 20 Periods is 75 200. The sum total of mean Julian time contained in them also, from April 29 at midnight A. M. 1 B. C. 4004 to April 9 at midnight A. M. 6081 A. D. 2077, is 6080 mean Julian years *minus* 20 days.

TABLE XXXI.

6000 mean Julian years	..	=	2 191 500 days.
80 — —	..	=	29 220 —
6080 — —	..	=	2 220 720 —
			−20
6080 mean Julian years − 20 days		=	2 220 700 days.

[1] See Fasti, i. 67. Diss. ii. ch. ii. sect. iii.

TABLE XXV.

			d.	h.	m.	s.	th.
70 000 Lunations	=		2 067 140	22	58	43	24·255 319 149
5 000	—	=	147 652	22	12	45	57·446 808 511
200	—	=	5 906	2	48	30	38·297 872 340
75 200	—	=	2 220 700	0	0	0	0·0

SECTION XIII. Table xxvi. Part i.—*Conversion of Degrees Minutes and Seconds of the Equator into Hours Minutes and Seconds of mean time.*

Part ii.—*Conversion of Hours Minutes and Seconds of mean time into Degrees Minutes and Seconds of the Equator.*

Since the diurnal rotation of the earth about its own axis goes on uniformly, and 360 degrees of the equator are thereby carried over the meridian in 24 hours of mean time; this is at the rate

of 15 degrees in one hour
of 1 degree in four minutes
of 1 minute in four seconds
of 1 second in four thirds,

and so on to any extent.

Conversely, 24 hours of mean time being the standing measure of 360 degrees of angular motion in right ascension; this too is at the rate

of 1 hour to every 15 degrees
of 1 minute to every 15 minutes
of 1 second to every 15 seconds,

and so on. And from these data respectively these two Tables have been calculated.

SECTION XIV. Table xxvii.—*Cycle of the Meridian Restitution, or of the return of the mean sun and of the mean equinoctial point to the meridian of the epoch. In periods of* 129 *mean tropical years of the Fasti.*

Table xxviii.—*Sum of mean solar time in integral days and decimal parts of a day, in the mean tropical year of the Fasti, from one year to* 7000 *years.*

What is here to be understood by the cycle of the Meridian Restitution, and what is the object proposed by the first of these two Tables in particular, will appear on referring to our general work[m]. At present we shall endeavour to con-

[m] i. 231. Diss. iv. Appendix, ch. ii.

fine ourselves to such explanations as have not been anticipated.

The Cycle exhibited in this Table is a great period of 4000 mean tropical years of the standard of our Fasti, or of 4000 mean Julian years constantly equated to 4000 mean tropical; which nevertheless, from a singular combination of elements, is made up of very disproportionate parts; 3999 years of either kind *plus* one more: i. e. 4000 in all. It began with the ingress of the first mean vernal equinox for the primary meridian, coinstantaneously with the beginning of mundane time itself; i. e. at the epoch of the Mosaïc creation, A. M. 1 B. C. 4004: and it was completed for the first time, and began to be described a second time, at the ingress of the 4001st mean vernal equinox for the same meridian, A. M. 4001 B. C. 4; only eleven days before the Nativity of our Lord Jesus Christ itself: the mere statement of which two facts is sufficient to justify the conclusion that, for some reason or other, (well known to the Author of time, whether made known to us or not,) this cycle of the restitution of meridians was equally connected with each of those great events, the Mosaïc creation and the Nativity; and for some adequate reason or other must be completed once at least in its integrity between the two.

In this xxviith Table we make use of the symbols A and A a, B and B b.

A is the right ascension of the equinoctial sun supposed to be constantly stationed in the point of the mean vernal equinox, and to participate in none of the motions of the actual sun except *that one* by which it is carried round the heavens once in the course of 24 hours of mean solar time; that is in none but the diurnal revolution. And this right ascension in the first instance of all is reckoned from the proper epoch of the noctidiurnal cycle, which is necessarily 24 hours or 360 degrees of right ascension behind the point at which the epact of the mean tropical year accumulates, or may be assumed to accumulate, to an entire period of 24 hours perpetually[n]. A is the right ascension of the equinoctial sun so reckoned in degrees of the equator and their constituent parts; i. e. in mean angular motion. A a is the correspond-

[n] See our Fasti, i. 472. Diss. vi. ch. iv. sect. iv.

ing amount of the same thing in time, such as is shewn perpetually by the reduction of right ascension (in the sense of mean angular motion) to time according to Table xxvi, P. i. B is the complement of A on 360°; and B b is the complement of A a on 24 hours*.

The Table itself is divided into equal periods of 129 mean tropical or mean Julian years respectively, 31 in all, from A. M. 1 B. C. 4004 to A. M. 4000 B. C. 5; = 3999 mean tropical or mean Julian years. And there is one year more included in it, the first year of the 32d period, necessary to make up the sum of 4000 years, coinciding with A. M. 4001 B. C. 4. One Cycle of this description was all for which we had any occasion. But the Table might easily have been expanded into a second; and in fact into any number of such Cycles which might have been proposed.

If a Table, adapted to particular years and analogous in principle to that which is here exhibited in periods of 129 years, is considered a desideratum; division B (the solar cycle of our General Tables) will be found to supply that desideratum perpetually. The solar cycle of our Fasti is just the same thing for particular years as this Table for the period of 129 years. Column B in the General Tables is virtually the same thing as column A a in this particular Table: and in this particular Table itself we might, if we had pleased, have dispensed with every thing but column A a.

In division B however of the General Tables as adapted to the representation of a meridian cycle like this in *annis expansis*, it must be supposed that the right ascension of the equinoctial sun, (in the sense in which we have explained it,) having once been determined in a certain manner by the law of the cycle at the beginning of every equinoctial year, continues the same all through that year; and at the end of this year is increased all at once by an amount equal to the epact

* It is however to be observed that the epoch of this Table, as here exhibited, being adapted to the hypothesis that the primary vernal Ingress for the meridian of our Tables took place 11 m. 9 s. 36 th. before midnight, instead of 21 s. 36 th. exactly past midnight, (which was the real state of the case;) it requires a slight correction: Column A, of + 2° 52′ 48″: column A a of + 11 m. 31 s. 12 th.: column B of − 2° 52′ 48″: and column B b of − 11 m. 31 s. 12 th.; all through at the beginning of each Period.

of the mean tropical year, 87° 12′ 36″ in degrees of the equator, 5 h. 48 m. 50 s. 24 th. in time. In this particular Table the right ascension, having been once determined by the law of the revolution at the beginning of one of these periods of 129 years, continues the same in terms for the whole of that period; and is then all at once augmented by an amount equal to the accumulation of the epact through that entire space of time, over and above integral cycles of 360° in angular motion and 24 hours in time: i. e. by 90° 5′ 24″ in degrees of the equator and by 6 h. 0 m. 21 s. 36 th. in time.

It is also to be observed that, in the course of this first Period of 4000 years, the values of A and A a, (the right ascension of the equinoctial sun in angular motion and in time,) and the corresponding values of B and B b respectively, twice experienced a change, *extra ordinem*, A and A a of the nature of a diminution, B and B b of that of an augmentation, of their proper amount; A and B one of 180°, A a and B b one of 12 hours each: once B. C. 1520 and again B. C. 710. This change was no necessary consequence of the cycle itself and of its proper law. It was due to a cause entirely distinct from that; the two miracles affecting the sun, of which enough has been said in the proper place elsewhere [o]. And yet neither of these changes interfered with this cycle of the meridian restitution. Neither antedated or procrastinated the return of the cycle to its first principles at the proper time. The only difference which they occasioned was this: that, by virtue of these two interruptions and of their joint effect, the equinoctial sun, in returning to the same relation to this cycle of meridians from which it set out, had one entire revolution of the heavens *de facto* to make less than it would otherwise have had. That however the joint effect of both these interruptions on this cycle was so limited was after all due to the actual amount of the diminution of right ascension on each occasion; and had it been either more or less than 180 degrees in space and 12 hours in time on each occasion, (any thing at least more or less than an entire revolution or half an entire revolution,) the cycle of restitution must have been interfered with by it. It could not have taken place at the time when it did, and in the manner in

[o] Vol. i. 237–383. Diss. v: vol. iv. Appendix, ch. i–iv.

which it did, at last. And this consideration (as we argued before[p]) ought to have its weight in deciding the question of the addition made to the length of the mean natural day on each occasion; and in particular with respect to the instantaneous restitution of the sun on the second occasion, from a certain position in the west to the opposite point in the east, 180 degrees exactly distant from it.

The element which enters this xxviith Table perpetually at bottom is the minute quantity of 5′ 24″ in right ascension or mean angular motion, and the equally small quantity of 21 s. 36 th. which measures this angle in time. The former enters 4000 times exactly into the entire circumference of the equator; the latter 4000 times exactly into the integral period of 24 hours: for 5′ 24″ × by 4000 = 360°; and 21 s. 36 th. or 21·6 s. × by 4000 = 24 hours. The former is consequently contained 1000 times in every 90° or quadrant of the equator; and the latter 1000 times in every 6 hours or quarter of the period of 24 hours. In like manner the former is comprehended 31 times in 2° 47′ 24″, the complement of 87° 12′ 36″ on 90°; and the latter 31 times in 11 m. 9·6 s. the complement of 5 h. 48 m. 50·4 s. on 6 hours: and therefore the former must be contained 969 times in the arc of 87° 12′ 36″, and the latter 969 times in the corresponding amount in time 5 h. 48 m. 50·4 s.

The state of the case then all through this xxviith Table is virtually the same as if the entire circumference of the equator were divided into 4000 meridians[q], each of them 5′ 24″ in arc and 21 s. 36 th. in time distant asunder; 969 of which in order perpetually corresponded to a difference in right ascension of 87° 12′ 36″ in angular motion, and to one of 5 h. 48 m. 50 s. 24 th. in time. And this being the amount both in space and in time, by which the right ascension of the equinoctial sun is annually augmented in division B of our General Tables; the effect is the same in the application of the cycle of meridians to that Table as if the *locus* of the equinoctial sun were transported *per saltum* every year over 969 of these meridians in our Tables, and yet coincided for a whole year with the 970th: but in such an order of succession as to coincide once in its turn, and at the same distance

[p] i. 299. Diss. v. ch. iii. sect. viii. [q] Cf. ii. 62. Diss. ix. ch. iii. sect. iii.

of time asunder as well as for the same length of time with each; yet never with the same again, and under the same circumstances as before, until after the lapse of 4000 years.

SECTION XV.—*On the principle of equinoctial time as embodied in this Cycle of Meridians.*

It is manifest too, after the preceding explanations, that, in this division B of our General Tables and in this xxviith of our Supplementary Tables, the principle of mean equinoctial time is both embodied and applied in its most legitimate form and to its utmost possible extent. It has been recommended of late years by the astronomers themselves[r] that, as mean equinoctial time is independent of local peculiarities and is consequently capable of being enunciated in the same form and understood in the same way for every meridian under the sun, it should be adopted as a general expression of time in preference to any other. For mean equinoctial time (as the name implies) being dated from the arrival of the mean sun at the point of the intersection of the plane of the equator with the plane of the ecliptic, the point of the mean equinox; it bears date from a physical fact which is coinstantaneous in its occurrence at all parts of the surface of the earth alike: and in time of its own denomination, (i. e. reckoned perpetually from the absolute instant of this fact,) it must be similarly exprest and similarly understood for each.

Now both the theory and the details of this mode of reckoning time are exemplified in the above cycle of the meridian restitution; first and properly indeed for the primary meridian, that of Jerusalem, but secondarily and through that for any other meridian whatsoever.

For the primary meridian, mean equinoctial time (i. e. the instant when it is 0 d. 0 h. 0 m. 0 s. reckoned from the point of the mean vernal equinox) is shewn at the beginning of every year in division B of our General Tables, and at the beginning of every 130th year in column A a of this xxviith of our particular Tables. And the mean equinoctial time, thus determined and thus indicated, at the beginning of

r Supplement to the Nautical Almanac for 1828. Explanations of the Nautical Almanac. Outlines of Astronomy, by Sir John Herschel, A. D. 1849, part iv. ch. xviii. § 935 sq. page 640.

every year, for the primary meridian, remains the same for that meridian all through the year; in every thing but the number of integral days so dated and reckoned successively from that primary ingress all round the year: and it is essential to the principle and application of this mode of reckoning mean time perpetually that it should do so. In the case of a given meridian indeed the zero or epoch of this reckoning is necessarily advanced at the beginning of every successive year to the amount of the epact of the mean equinoctial year itself; and therefore for any one meridian perpetually this epoch must always be shifting its place in the period of 24 hours, reckoned from noon or midnight perpetually. Consequently mean solar time reckoned by this period from noon or midnight perpetually, and mean equinoctial time reckoned from the point of the vernal equinox in the same period of 24 hours also, for a given meridian cannot coincide perpetually, though they may have done so once. And yet there will always be some meridian, and in every year, of which the mean equinoctial time will coincide with the mean solar, for the time being; and each also as reckoned by the same period of 24 hours, and from the same positive epoch of the reckoning, whether noon or midnight.

In the Nautical Almanac this meridian is spoken of as an *itinerant* meridian, which was every year changing its place to the west relatively to that of Greenwich. But it is scarcely correct to call it an itinerant meridian, unless the meridian cycle, which we have hitherto been describing, is an itinerant cycle too: for this secondary meridian merely follows the course of the original or primary one. Both run through the same cycle of changes and alternations; and both complete it in the same length of time, the great period of 4000 years.

At the beginning of this great period A. M. 1 B. C. 4004, the meridian which had its mean equinoctial time equal to its mean solar time, (and both as reckoned from the same point, mean midnight, and both as measured by the same measure, the period of 24 hours of mean solar time,) was the primary meridian itself, and any other meridian which was 360°, or one entire period of 24 hours of right ascension, west of that. At the beginning of the next year, A. M. 2 B. C.

4003 the mean equinoctial time of the primary meridian and the mean solar would begin to differ by 5 h. 48 m. 50·4 s.= 87° 12′ 36″ in angular motion; and the meridian, the mean equinoctial and the mean solar time of which would now be agreeing under the same circumstances as those of the primary meridian the year before, must be that which was situated just 87° 12′ 36″ west of the primary: but still in 360° as before. And it is manifest that all through the great cycle of 4000 years, at the beginning of every fresh equinoctial year, a different meridian would step into the place of that which had its mean equinoctial and its mean solar time the year before (each reckoned by its proper rule) equal all through the year; yet still a meridian which stood in the same kind of relation to the primary every year: a meridian always so situated in respect of the primary as to be constantly west of it; a meridian always situated for the time being in the epoch of right ascension itself in the sense explained above, yet always so many degrees minutes and seconds west of the primary meridian as there were degrees minutes and seconds in the right ascension of the equinoctial sun, reckoned from the same point, at the beginning of the same year. The mean equinoctial time of such a meridian and the mean solar, for the time being, must necessarily be the same; and each must bear date alike from the point of midnight as well as from the point of the equinox also.

It is proposed indeed by the authorities above referred to, that, in conformity to the rule which has hitherto regulated the use of every other description of mean time among astronomers in particular, mean equinoctial time should be dated conventionally from mean noon. And should these suggestions ever be carried into effect; (assuming only that the proper epoch of the reckoning whether from mean noon or from mean midnight is still to be the mean vernal ingresses of our own Fasti;) we have compiled the xxviiith Table as an accompaniment to the xxviith—and as a means of facilitating this reckoning from either of these epochs, mean noon or mean midnight alike.

Since equinoctial time by hypothesis is to be dated from the mean equinox, (i. e. from the instant of time when it is 0 d. 0 h. 0 m. 0 s. reckoned from the arrival of the mean sun

at the mean equinox for a given meridian,) this moment according to our assumptions and for the meridian of Jerusalem was April 25 at midnight A. M. 1 B. C. 4004. And at the moment of midnight for this particular meridian April 25 A. M. 1 B. C. 4004, it was 0 d. 0 h. 0 m. 0 s. in mean equinoctial time. But 12 hours of mean time later, i. e. at mean noon exactly, on the same day in the same year and for the same meridian it was already 0 d. 12 h. 0 m. 0 s. of mean equinoctial time; that is, 0 d·5. The epoch of mean equinoctial time therefore, from A. M. 1 B. C. 4004 downwards perpetually, for the primary meridian, dated from mean midnight would be 0 d·0; dated from mean noon would be 0 d·5. And as mean equinoctial time dated perpetually from a fixed epoch, mean midnight or mean noon next after the ingress of every fresh equinoctial year, in the scheme of our Fasti is nothing but the complement of the mean equinoxes of our Tables on 24 hours or on 12 hours; (on 24 hours, referred to midnight, on 12 referred to noon, when they fall between midnight and noon, on 12 referred to midnight, and 24 referred to noon, when they fall between noon and midnight;) it is manifest that having the epoch of the entire succession given, whether midnight or noon, we have nothing to do but to subtract from it the epact of the mean tropical year, 0d·24225 in decimal parts of a day, or the sum total of that epact for the given number of years, (having first cast off all the integral periods of 24 hours which enter into it,) and we shall get the mean equinoctial time at mean midnight or at mean noon, at the beginning of any year which may be proposed, without any further trouble.

Let this rule be tried on A. D. 1828, in which year this new mode of reckoning mean solar time was first introduced and first recommended to general use.

M. V. E. A. M. 1. *B. C.* 4004—*M. V. E. A. M.* 5832.
A. D. 1828=5831 *mean tropical years.*

TABLE xxviii.

Years.		d.
5000	=	1 826 211·25
800	=	292 193·80
30	=	10 957·2675
1	=	365·24225
5831	=	2 129 727·55975

We have therefore

A. M. i. Epoch of Eql. T.	0 d·0	or midnight
5831 years,	− ·55975	
A. M. 5832 Epoch	0 d·44025 = 10 h. 33 m. 57·6 sec.	
A. M. i. Epoch	0 d·5	or noon.
5831	− ·55975	
5832	0 d·94025 = 22 h. 33 m. 57 s·6	

Now A. M. 5832 A. D. 1828, we have the Tabular mean V. E.,

			h.	m.	s.
	March	8	13	14	52·8
Correction	+	2	0	11	9·6
True M. V. E. ..	March	10	13	26	2·4
Equinoctial time at mean midnight, A. D. 1828.. ..	+		10	33	57·6
	= March	11	0	0	0·0
	March	10	13	26	2·4
Equinoctial time at mean noon,	+		22	33	57·6
	March	11	12	0	0·0

In this instance the mean equinox of the Tables fell between noon and midnight. The year before it fell between midnight and noon. In this year A. D. 1827 = A. M. 5831, the sum of the epact was ·3175; and 0 d·0 — ·3175 = ·6825 and 0 d·5 — ·3175 = ·1825: the former = 16 h. 22 m. 48 s. the latter to 4 h. 22 m. 48 sec. A. D. 1827 the true mean vernal equinox, from the Tabular corrected as before, was March 11, 7 h. 37 m. 12 sec.: and 16 h. 22 m. 48 s. the equinoctial time at mean midnight next ensuing A. M. 5831 is the complement of that on 24 hours; 4 h. 22 m. 48 sec. the equinoctial time at mean noon next ensuing is its complement on 12 hours.

With respect to any other meridian, (for instance that of Greenwich,) equinoctial time for this meridian A .M. 1 B. C. 4004 was 0 d. 0h. 0 m. 0 s. at 21 h. 39 m. 13 sec. after midnight, April 24; and therefore was 2 h. 20 m. 47 sec. or 0 d·097 766 2 at midnight April 25; 0 d·597 766 2 at mean noon, the same day. Hence, for this meridian, A. M. 5832 A. D. 1828, we have

d.
0·597 766 2
—·559 75
0·038 0162 = 0 h. 54 m. 44·6 s.

Equinoctial time at mean noon, A. D. 1828. We had the M. V. E. at Jerusalem that year,

		h.	m.	s.
	March 10	13	26	2·4
	—	2	20	47
At Greenwich	March 10	11	5	15·4
Comp. on 12 h. equinoctial time at mean noon,	+	0	54	44·6
	March 10	12	0	0·0

The true mean equinox indeed for this meridian A.D. 1828 according to the solar Tables of Delambre and sir John Herschel[s] was March 22 (=10) at 13 h. 2 m. 59.05; so that the equinoctial time at mean noon next after the equinox was the complement of 24 hours not of 12. Our own Tabular Equinox is reduced to Delambre's by adding to it the difference of standards (Delambre's mean tropical year and ours) for 5831 years. This difference = 0 d·000 014 in one year, and therefore 0 d·000 014 × 5831 or 0 d·081 634 in 5831 years. We add this to the sum of the epact, 0 d·55975, in 5831 years; and subtract the sum, 0 d·641 384, from the equinoctial time of the epoch, at mean noon, A. M. 1, 0.597 766 2. The difference is 0 d·956 382 2 = 22 h. 57 m. 11.422 sec. We have then the mean V. E. at Greenwich A. D. 1828, according to sir John Herschel,

		h.	m.	s.	
	March 22	1	2	59·05	from noon.
Comp. on 24 h. equinoctial time	+	22	57	11·422	
	March 23	0	0	10·472	mean noon.

There is an excess indeed of 10·472 sec. in this instance above the point of mean noon, concerning which we have said something elsewhere[t]. According to sir John Herschel himself[u] mean equinoctial time for the meridian of Greenwich at mean noon, A. D. 1828, was 0 d.956 261. The difference between this and what we have made it, (0 d·956 382 2) is 0 d.000 121 2 = 0 h. 0 m. 10.471 68 sec. also.

SECTION XVI. Table xxix.—*Sum of mean solar time in mean solar days and nights, in the equable year, Cyclical or Nabonassarian, from one to* 7000 *equable years.*

[s] Outlines of Astronomy, §. 937. p. 642.

[t] Vol. iv. Appendix, ch. i.

[u] Outlines of Astronomy, § 938. p. 643.

Table xxx.—*Sum of mean solar time in mean solar days and nights, in the mean tropical year of the Fasti, from one to 7000 tropical years.*

Table xxxi.—*Sum of mean solar time in mean solar days and nights, in the mean Julian year, from one to 7000 Julian years.*

Table xxxii.—*Sum of mean solar time in mean solar days and nights, in the mean sidereal year of the Fasti, from one to 7000 sidereal years.*

Table xxxiii.—*Sum of mean solar time in mean solar days and nights, in the mean anomalistic year of the Fasti, from one to 7000 anomalistic years.*

Table xxxiv.—*Precession of the mean Julian year on the mean tropical of the Fasti, from one to 7000 years.*

Table xxxv.—*Precession of the mean sidereal year of the Fasti on the mean tropical, from one to 7000 years.*

Table xxxvi.—*Precession of the mean anomalistic year of the Fasti on the mean tropical, from one to 7000 years.*

Table xxxvii.—*Precession of the mean sidereal year of the Fasti on the mean Julian, from one to 7000 years.*

Table xxxviii.—*Precession of the mean anomalistic year of the Fasti on the mean Julian, from one to 7000 years.*

Table xxxix.—*Precession of the mean anomalistic year of the Fasti on the mean sidereal, from one to 7000 years.*

The first five Tables which follow (from the xxixth to the xxxiiid both inclusive) are sufficiently intelligible from their titles. They are intended to shew the sum of mean solar time, measured by the period of 24 hours perpetually, in the equable year, in the mean tropical, in the mean Julian, in the mean sidereal, and in the mean anomalistic, respectively, from one year to 7000 years of each kind.

It is superfluous to say any thing more in this part of our work of the equable year, of the mean tropical of the Fasti, or of the mean Julian. But with respect to the mean sidereal year, it is usually defined by astronomers to denote the interval, measured in mean solar days and nights and their aliquot parts, which is observed to elapse between the de-

parture of the sun from a given point of the ecliptic, assumed to be fixed, in one instance, and its return to it and its departure from it again, in the next. Any point of the ecliptic is competent to answer this purpose of defining the beginning and the end of the mean sidereal year perpetually; whether it is also the locus of a star or not. But if some such object as a star is always on that point or near it, the name of the mean sidereal year, so defined and so measured perpetually, applied to this complex of mean solar time, is only so much the more proper for it.

It has not been known to modern astronomers, (though it was always possible to have been so known, and if we are not mistaken it was well known to the astronomers of antiquity, especially to those of Egypt,) that the mean sidereal year in this sense never had a different beginning, in constant connection with the present system of things, from that of the mean tropical; that at the actual beginning of this system and at the moment of the mean vernal equinox for the primary meridian the sun was in conjunction simultaneously with two remarkable stars, both situated in the zodiac: two stars which (if we may venture without presumption to express such an opinion) the Creator himself might have purposely so disposed, to define and point out both the beginning and the end of the sphere of his own constitution, the Primitive Sphere of all mankind, the Mazzaroth or Mazzaloth of Holy Writ[w].

When the ancient Egyptians in aftertimes laid down the zodiacal figures on the surface of the sphere, with a singular felicity in the choice of the position, they fixed these two stars on the top of the horns of the Bull; one on the north horn the other on the south horn. Since this time they have always made part of the constellation of the Bull; and they are still known to astronomers by the names of B῀ητα and Z῀ητα Tauri respectively.

The position of these stars relatively to the ecliptic is such that the actual path of the sun along that circle passes between them; and if these two stars be supposed to be joined by an arc of the sphere, and two lines to be let fall, one from one of these stars the other from the other, perpendicular to

[w] Fasti, iii. 250. Diss. xv. ch. iii. Sect. ii: 258. Sect. iv.

the ecliptic; the distance of the point of intersection of either with the ecliptic from the arc, which connects them, even at present is nearly the same, and originally was probably much more so. At the beginning of things these two stars were situated about one degree on either side of this arc of conjunction; *βῆτα* Tauri to the west of it, *ζῆτα* Tauri to the east: while the sun at the same point of time was stationed as nearly as possible on the point of the intersection of this arc with the ecliptic itself.

Under such circumstances it is evident that the mean tropical year, determined and measured perpetually by the departure of the mean sun from the point of the mean vernal equinox and by its returns to it again, and the mean sidereal year, similarly defined and limited by the departure of the mean sun from the arc of conjunction of these two stars and by its returns to it again, must have had the same actual beginning; and that as the mean tropical year of our earth has always borne date from the article of the primary mean vernal equinox, that of A. M. 1 B. C. 4004 for the proper meridian, so has its mean sidereal year always done so from this primary mean conjunction with *βῆτα* and *ζῆτα* Tauri: whether astronomers have been aware of the fact or not. The mean sun was in that state of conjunction with these two stars for the primary meridian, April 25 at midnight, B. C. 4004. At present it is so every year on or about June 1 Old style, June 13 New style.

The mean length of the sidereal year, which we deduce from the mean tropical year of our Fasti and the mean annual rate of the precession[x], is the quotient of the sum of mean solar time contained in 25 885 tropical years divided by 25 884: viz. 365 d. 6 h. 9 m. 9 sec·567 454 798 331. The length of our tropical year is 365 d. 5 h. 48 m. 50·4 s. Consequently the excess of our mean sidereal year over our mean tropical is 20 m. 19 sec·167 454 798 331. And this is the time which, with the mean motion of our solar Tables, corresponds most exactly to the arc of precession,

$$50''\cdot069\ 541\ 029\ 207\ 232\ 267,$$

which makes the real difference between the mean tropical year and the mean sidereal perpetually[x]. It is very observ-

[x] Fasti, iv. 146, 147. Diss. xv. ch. xiii. sect. ix.

able that the mean sidereal year thus obtained differs by a scarcely appreciable quantity from that which is proposed in Mr. Baily's Tables and Formulæ[y],

365·256 361 2=365 d. 6 h. 9 m. 9 sec·607 68:

though that of Bessel indeed is

365·256 374 417=365 d. 6 h. 9 m. 10·749 628 8 sec.[z]

The mean anomalistic year, as astronomers call it, is the interval measured in mean solar time which is observed to elapse between the departure of the sun from the apogee or the perigee of the solar orbit in one instance and its return to it again in the next. Historical chronology has no particular occasion for this form of the mean solar year; but astronomers make frequent use of it: for which reason we have given it a place in our Tables. Besides which it is by all means desirable to shew that the proper anomalistic year of our own system has no absolute epoch in constant connection with it different from that of the proper equable, the proper tropical, the proper Julian, the proper sidereal also. We have already seen[a] that A. M. 1 B. C. 4004, at the commencement of things, the apogee of the solar orbit itself was coinciding with the mean vernal equinox. It follows that as the mean tropical and the mean sidereal, so the mean anomalistic, year, with which our own system always has been and still is properly connected, must have taken its rise together with the rest: and all, in conjunction with this system, at the point of the mean and of the true vernal equinox A. M. 1 B. C. 4004.

The difference of the mean anomalistic year of our Fasti and the mean tropical year is the arc of 61″·729 541 reduced to mean solar time; and this being compounded of two elements, the arc of precession, 59″·069 541 and the arc described every year by the line of the apsides eastward, 11″·66, we obtain this difference in mean solar time most exactly as follows:

			d.	h.	m.	s.
i.	50″·069 541	=	0	0	20	19·167 454 798 331
	11 (Table viii P. ii)	=			4	27·844 316 666 52
	·6	=				14·609 689 999 992
	·06	=				1·460 968 999 999 2
	61·729 541	=	0	0	25	3·082 430 464 842 2
	Mean tropical year ..	..	365	5	48	50·4
	Mean anomalistic year	..	365	6	13	53·482 430 464 842 2

y P. 16. z P. 270. a Supra, 202. Cf. Fasti, ii. 130. Diss. ix. ch. vi.

We have added to these Tables of mean solar time six Tables of Precession, (Table xxxiv—xxxix); by which term we understand in this instance the excess of one of these forms of the mean solar year over another, the greater over the less: the excess of the mean Julian mean sidereal and mean anomalistic over the mean tropical, the excess of the mean sidereal and mean anomalistic over the mean Julian, and the excess of the mean anomalistic over the mean sidereal.

		m.	s.	
Precession of the mean Julian over the mean tropical	=	11	9·6	of mean solar time.
Of the mean sidereal	=	20	19·167 454 798 331	
Of the mean anomalistic	=	25	3·082 430 464 842 2	
Precession of the mean sidereal over the mean Julian	=	9	9·567 454 798 331	
Of the mean anomalistic	=	13	53·482 430 464 842 2	
Precession of the mean anomalistic over the mean sidereal	=	4	43·914 975 666 511 2	

In these Tabular schemes of the Precession in question however we proceed upon an hypothesis which is partly true and partly not so; viz. that either these various forms of the mean solar year, thus compared together, proceed in periods of four years alike, and therefore have a common cycle of leap-year; or that the Julian year, compared with each of the other three, increases like them regularly every year by an amount of mean solar time equal to its proper epact over and above the integral period of 365 days and nights complete.

This hypothesis may be considered true and consistent with the matter of fact, in the case of the mean tropical, the mean sidereal, and the mean anomalistic years. All these years took their rise together, A. M. 1 B. C. 4004, at the same moment of time; and all have since proceeded together in conjunction both year by year, and in periods or cycles of four years perpetually. In the case of these three kinds of year therefore, and in the comparison of one with another, the greater with the less, the Tabular Precession must always represent the truth.

But with respect to the Julian year, there is no such thing *de facto* as the mean Julian year of 365 days 6 hours perpetually. There is none such but the year of 365 days at

one time and of 366 at another. In the case of the Julian year therefore the Tabular Precession will not always correctly represent the excess of the actual Julian year over the mean tropical, or that of the mean sidereal or the mean anomalistic year over the actual Julian. It will do so only when the mean Julian time of this Table of Precession is equal to the actual Julian; that is, once in four years and in the second year of the proper Julian cycle of leap-year.

For as the first year of mundane time, the first year of each of these kinds of year alike, *de facto* coincided with the second year of the Julian cycle of leap-year, B. C. 4004, not with the first, B. C. 4005; if they proceeded in the period of four years ever after in common, the epoch of that period must have been the second year of the Julian cycle of leap-year: and the Julian leap-year, in the proper Julian cycle of that kind, must be the third year of such a period perpetually. The rule then is, having given a certain number of years from A. M. 1 B.C. 4004, both in the Julian æra, and in that of any other of these kinds of years, to divide it by four; and if there is no remainder, the Tabular Precession of the mean Julian year of the given amount over the same number of mean tropical years, or the Tabular Precession of the given number of mean sidereal years or of mean anomalistic years over the given number of mean Julian, will agree to the same thing in the actual Julian also. If there be a remainder of one, the Tabular Julian Precession must be diminished by 6 hours. If a remainder of 2, it must be diminished by 12 hours. If there be a remainder of three, this will imply that the last year of the number is leap-year in the actual Julian year of the same time; and therefore the Tabular Precession in this case, but in this only, must be increased by 6 hours.

We may illustrate the relation of these various Tables to each other, and at the same time verify the accuracy of each, by finding both the sum of mean solar time and the different amounts of the Precession in each, for 5804 years, from A. M. 1 B. C. 4004 to A. M. 5805 A. D. 1801.

i. Table xxx. 5804 years.

	d.	h.	m.	s.
5000 =	1 826 211	6	0	0
800 =	292 193	19	12	0
4 =	1 460	23	15	21·6
5804 =	2 119 866	0	27	21·6

ii. Table xxxi. 5804 years.

	d.
5000 =	1 826 250
800 =	292 200
4 =	1 461
5804 =	2 119 911

iii. Table xxxii. 5804 years.

	d.	h.	m.	s.
5000 =	1 826 281	19	17	17·274
800 =	292 205	2	7	33·964
4 =	1 461	0	36	38·270
5804 =	2 119 947	22	1	29·508

iv. Table xxxiii. 5804 years.

	d.	h.	m.	s.
5000 =	1 826 298	5	36	52·152
800 =	292 207	17	13	5·944
4 =	1 461	0	55	33·930
5804 =	2 119 966	23	45	32·026

iv. Table xxxiv. 5804 years.

5000 =	38	18	0	0
800 =	6	4	48	0
4 =			44	38·4
5804 =	44	23	32	38·4

v. Table xxxv. 5804 years.

5000 =	70	13	17	17·274
800 =	11	6	55	33·964
4 =		1	21	16·670
5804 =	81	21	34	7·908

vi. Table xxxvi. 5804 years.

5000 =	86	23	36	52·152
800 =	13	22	1	5·944
4 =		1	40	12·330
5804 =	100	23	18	10·426

vii. Table xxxvii. 5804 years.

5000 =	31	19	17	17·274
800 =	5	2	7	33·964
4 =			36	38·270
5804 =	36	22	1	29·508

viii. Table xxxviii. 5804 years.

5000 =	48	5	36	52·152
800 =	7	17	13	5·944
4 =			55	33·930
5804 =	55	23	45	32·026

ix. Table xxxix. 5804 years.

5000 =	16	10	19	34·878
800 =	2	15	5	31·981
4 =			18	55·660
5804 =	19	1	44	2·519

It is manifest too that, having the sum of mean solar time in 5804 mean tropical years given from Table xxx, we can obtain the sum in the same number of mean Julian, mean sidereal, and mean anomalistic years, by adding to it the Precession from these different Tables.

	d.	h.	m.	s.
i. Table xxx. 5804 tropical years	2 119 866	0	27	21·6
Table xxxiv.	+ 44	23	32	38·4
ii. Table xxxi. 5804 mean Julian years	2 119 911	0	0	0
Table xxxvii.	+ 36	22	1	29·508
iii. Table xxxii. 5804 mean sidereal years	2 119 947	22	1	29·508
Table xxxix.	+ 19	1	44	2·519
iv. Table xxxiii. 5804 mean anomalistic years	2 119 966	20	45	32·027
Table xxx. 5804 mean tropical years	2 119 866	0	27	21·6
Table xxxv.	+ 81	21	34	7·908
v. Table xxxii. 5804 mean sidereal years	2 119 947	22	1	29·508
Table xxx. 5804 mean tropical years	2 119 866	0	27	21·6
Table xxxvi.	+ 100	23	18	10·426
vi. Table xxxiii. 5804 mean anomalistic years	2 119 966	23	45	32·026

		d.	h.	m.	s.
Table xxxi. 5804 mean Julian years		2 119 911	0	0	0
Table xxxviii.	+	55	23	45	32·026
vii. Table xxxiii. 5804 mean anomalistic years		2 119 966	23	45	32·026

It is evident also that the 5805th tropical ingress, shewn by Table xxx, is altogether the same with that which is shewn A. M. 5805 A. D. 1801 in our Solar Cycle, division B of our General Tables.

A. M. 5805 A. M. 1801.

			d.	h.	s.
Tab. Mean V. E. ..	March	9	0	16	12
Correction ..	+	2	0	11	9·6
True Mean V. E. ..	March	11	0	27	21·6

	d.	h.	m.	s.
Table xxx. Sum of mean solar time in 5804 mean tropical years	2 119 866	0	27	21·6

The epoch of this Table in the first year being midnight; it is implied by this too that the 5805th vernal ingress took place 0 h. 27 m. 21·6 s. after midnight.

By means of these Tables of Precession also we may still further confirm the important truth of which we have so often had occasion to make mention; the depression of the epoch of mean annual Julian time, in constant connection with the present system of things, from April 25 to April 24.

The sum of mean solar time, measured perpetually by the period of 24 hours, in 5804 mean Julian years cannot be either more or less than 2 119 911 days. Now this sum of 2 119 911 mean solar days must be the same thing in itself whether it be reckoned from April 25 A. M. 1 to April 25 A. M. 5805, or from April 24 A. M. 1 to April 24 A. M. 5805. But if the primary epoch of mean annual Julian time in constant connection with the present system of things was actually April 25, and this primary epoch has never varied from itself even in terms; the sum of mean annual Julian time from A. M. 1 to A. M. 5805 must have been reckoned *de facto* perpetually from April 25 not from April 24.

We have seen then that the sum of mean solar time in 5804 mean tropical years *plus* the Precession of the same number of mean Julian years on that number of mean tropical is absolutely equal to the sum of mean solar time in

5804 mean Julian years reckoned from the same nominal Julian epoch to the same perpetually. If then this epoch has always been April 25, and April 25 has never varied even in terms, the mean annual Julian Precession in 5804 years added to the 5805th mean vernal ingress should bring us to April 25 A. M. 5805.

			h.	m.	s.
Now A. M. 5805 A. D. 1801 ..					
we have the mean V. E. ..	March 11		0	27	21·6
The Precession, 5804 years ..	+	44	23	32	38·4
	April 25		0	0	0·0

It appears then that the Precession, added to the 5805th vernal ingress, whether from Table xxx or from the General Tables, does actually bring us to April 25 at midnight, A,M. 5805; i.e. to the Julian epoch of origination of the entire succession of mean annual Julian time from A.M. 1 to A.M. 5805. And this would seem to be a sufficient proof that this Julian epoch of origination could never have varied, (at least in terms,) from A.M. 1 to A.M. 5805. But whether it might not have varied in reality though not in terms; that would still be open to question. It never could be considered to be decided by this kind of proof.

We are bound therefore to consider further that every Julian term, under whatsoever denomination, has its proper place in the order of the hebdomadal cycle, the order of hebdomadal feriæ; and that this order *de facto* has never varied from the beginning of things to the present day. The meaning and value of Julian terms, in one and the same nominal order of such terms, may have varied between these extremes; but the order of feriæ to which they have been perpetually attached (the actual order at least) has never varied, nor ever been disturbed. Now the feria of origination in the regular succession of such feriæ, in constant conjunction with Julian time both noctidiurnal and annual, and in constant connection with the present system of things, A. M. 1 was the feria *prima;* and therefore, as we demonstrated supra,[b] A. M. 5805 in the same kind of conjunction and in the same kind of connection, (never once interrupted down to that point of time,) this feria of origination must have been the feria *quarta.* If so, April 25 A. M. 5805 should have been the feria *quarta:*

[b] P. 218.

and yet it is certain that it was the feria *quinta:* and that April 24 was the feria *quarta.* What then can be inferred from these facts, except that April 24 was as truly the Julian exponent and Julian representative of the feria of origination A. M. 5805, as April 25 A. M. 1? Consequently that, while the nominal value of this perpetual Julian exponent and representative of the feria of origination has continued the same from A. M. 1 to A. M. 5805, its real value somewhere or other between these extremes has undergone a change; by virtue of which April 24 has stept into the place of April 25, a lower Julian term, in constant connection with the feria of origination, into the place of an higher: so that a lower Julian term in the regular order of such terms in constant connection with the actual and regular order of feriæ in the hebdomadal cycle, from the first, is now equivalent to an higher feria; i. e. to the next above itself.

It follows that if we would recover the Julian epoch of origination, from the mean vernal ingress and the Julian Precession in a particular year (after B. C. 672), we must diminish the latter by one day; just as in finding the true mean longitude of the Julian epoch of origination in any year after the same date, from the accumulated annual increment in Table x, we saw it was necessary to diminish this too by one day's mean motion, to make it express the truth[c]. But with regard to the relation of the mean tropical year to the mean sidereal and mean anomalistic, or to that of either of these years to the other; it does not appear that it is anything different at present from what it was at first. Each of these years, the mean sidereal and the mean anomalistic, set out at first from the same point as the mean tropical; the point of the mean vernal ingress A. M. 1: and each has gone on advancing upon that point at a certain rate annually ever since; and the absolute amount of that advance up to a given time has always been measured or measurable by our Tables of Precession, adapted thereto from the first.

The relation then of either of these forms of the mean solar year to the mean tropical has never varied. They stand in the same relation to the proper epoch of the mean natural

[c] Supra, page 217.

year, the point of the mean vernal ingress, at present as ever, *mutatis mutandis* only. The relation of each to the mean Julian year, with which too they set out in conjunction as much as with the mean tropical at first, has varied. They set out along with the mean Julian year at first on April 25: and therefore the advance or precession of either on the Julian year ever after was properly referrible to April 25. It began with being referrible to April 25: but it has ended in being referrible to April 24. And this is apparently the same thing as if the mean sidereal or mean anomalistic Precession on the mean Julian year had been diminished by a day; though in reality the Precession itself has always continued the same; but the Julian epoch to which it was constantly to be referred has undergone a change in terms amounting to a day: i. e. from April 25 to April 24. It is manifest that the sidereal Precession in 5804 mean sidereal years over 5804 mean Julian years is just the same in itself, and neither more nor less than 36 d. 22 h. 1 m. 29·508 sec. whether it be reckoned at present from April 25 or from April 24: and yet the sidereal epoch, A.M. 5805, reckoned from April 24 by means of this Precession would be May 30 22 h. 1 m. 29·508 sec. and reckoned from April 25 May 31 22 h. 1 m. 29·508 sec.: i.e. one day later in one of these cases than the other. The same thing holds good of the anomalistic Precession, 55 d. 23 h. 45 m. 32·026 sec.: which is just the same in itself whether referred to April 24 or to April 25: yet the epoch recoverable from the former is June 18 23 h. 45m. 32·026 s. and from the latter is June 19 23 h. 45 m. 32·026 s. The absolute sum of mean sidereal time in these 5804 mean Julian years is simply the absolute sum of mean Julian + the sidereal Precession in the same; and the absolute sum of mean anomalistic is the sum of mean Julian + the anomalistic Precession: and that too whether the sum of mean Julian is reckoned from April 25 A.M. 1 or from April 24 A.M. 1 perpetually.

Nor is it any difficulty that the epoch of mean sidereal time in one of these cases and that of mean anomalistic in the other, recoverable from the epoch of mean tropical *plus* the sidereal Precession, or the epoch of mean tropical *plus* the anomalistic Precession, is one day greater in each of these in-

stances, as our synopsis supra[d] shews. The epoch of reference in these latter instances is the point of the mean vernal ingress, the epoch of origination of mean annual natural time perpetually; that in the former is a fixed Julian term, the epoch of origination of mean annual Julian time. The former has continued the same in terms throughout, and has nominally maintained the same relation to every thing else perpetually. The latter has not continued the same in terms; though its real value may still be the same which it always was.

It follows from these several facts laid together, (and as it appears to us with demonstrative certainty,) that the Julian epoch of mean longitude (the epoch to which the cumulative effect of the increment in mean longitude in the mean Julian year is perpetually referrible), and the epoch of Julian Precession (the advance of the mean Julian on the mean tropical year), have both fallen back one day on the epoch of mean longitude properly so called and the epoch of mean natural annual time, the point of the mean vernal equinox; but that this epoch itself has never been disturbed. It remains the same in terms as ever, in all but the order of *feriæ*. It follows that the sum of mean sidereal time and that of mean anomalistic up to a given date are still the same which they were from the first; the sum of mean tropical time up to the same date, *plus* the sidereal Precession in the one case, and *plus* the anomalistic in the other; or the sum of mean Julian up to the same date *plus* the sidereal or *plus* the anomalistic Precession also. But the sidereal or the anomalistic epoch in its proper æra at a given time cannot now be obtained from the Julian epoch of origination *plus* the sidereal or *plus* the anomalistic Precession up to the same date; only from the epoch of mean tropical time (the epoch of mean longitude) *plus* the Precession. The latter still gives it correctly; the former at present one day in defect of the truth in terms at least..

SECTION XVII. Table xl.—*Diurnal Acceleration of the mean sidereal day on the mean solar day in mean sidereal time, from one day to* 365 *days.*

Table xli. Part i.—*Conversion of hours of mean solar time into*

[d] P. 246.

mean sidereal, or Complement of mean solar hours in mean sidereal time, from one hour to 24.

Part ii.—*Conversion of minutes of mean solar time into mean sidereal, or Complement of the mean solar minute in mean sidereal time, from one minute to* 60.

Part iii.—*Conversion of seconds of mean solar time into mean sidereal, or Complement of the mean solar second in mean sidereal time, from one second to* 60; *also of decimal parts of the mean solar second from one to ten.*

Table xlii.—*Diurnal Anticipation of the mean sidereal day on the mean solar day in mean solar time, from one day to* 365 *days.*

Table xliii. Part i.—*Conversion of hours of mean sidereal time into mean solar, or Correction of the mean sidereal hour, from one hour to* 24.

Part ii.—*Conversion of minutes of mean sidereal time into mean solar, or Correction of the mean sidereal minute, from one minute to* 60.

Part iii.——*Conversion of seconds of mean sidereal time into mean solar, or Correction of the mean sidereal second, from one second to* 60; *also of decimal parts of the mean sidereal second from one to ten.*

The interval, measured in mean solar time, which is observed to elapse between the passage of a given star over a given meridian in one instance, and the return of the same star to this meridian, and its passage over it again, is called by astronomers the mean sidereal day. This interval is absolutely invariable[e]. It is therefore the absolute measure of duration by the revolution of the earth about it's own centre; i.e. by the diurnal rotation[e]. And angular motion being measured or measurable by time perpetually, its proper measure in time is the sum of mean time which corresponds to an angular motion of 360 degrees in right ascension.

The return of a given meridian to the mean or hypothetical sun[e] is a measure of duration too, but in terms not of the diurnal rotation, (at least directly,) but of the mean noctidiurnal cycle, or mean cycle of day and night; and this

[e] Fasti, i. 47–58. Diss. ii. ch. i. section i—v.

measure also is invariable, and the same for every meridian under the sun, 24 hours of mean solar time alike for each. But it is a greater measure of duration of its kind than that of the diurnal rotation; only in a fixed and invariable proportion, each being estimated in terms of mean solar time alike.

The noctidiurnal cycle or mean solar day and night is subdivided into 24 smaller parts, equal one to another, called mean solar hours; the mean solar hour is subdivided into 60 equal parts called mean solar minutes; the mean solar minute into 60 equal parts called mean solar seconds: and so on. The mean sidereal day is subdivided in like manner into 24 mean sidereal hours; the mean sidereal hour into 60 mean sidereal minutes; the mean sidereal minute into 60 mean sidereal seconds: and so on. And as the chronometers or time-pieces of every kind, (clocks, watches &c.) which are intended for common use, are so constructed as to keep and shew mean time of the former description perpetually; so are those, which are intended for the use of astronomers and are kept in astronomical observatories, so contrived and constructed as to keep and shew mean time of the latter description. Between these two kinds of mean time in general, (both in the sum total and in the parts,) one in terms of the other, there is a standing difference, though both are divided and denominated alike. The mean sidereal day is less than the mean solar day in a certain proportion; the mean sidereal hour than the mean solar hour in a similar proportion, and so on: though the name of a day and that of an hour are given to both alike.

The Divine Wisdom at the beginning of things, whensoever that was[f], seems to have been pleased so to adjust the *actual* rate of the diurnal rotation, and the *mean* rate of the annual revolution, of the same material subject, our own planet, the earth; that the mean solar day and the mean sidereal day should each be the same accurate measure of the diurnal revolution in terms of the annual perpetually; that 366 d. 5 h. 48 m. 50 sec·4 or 366·24225 returns of the same meridian to the same star or absolute point of space, and 365 d. 5 h. 48 m. 50 sec·4, or 365·24225 returns of the same meridian

[f] Cf. Fasti, ii. 365 note. Diss. xi. ch. iv. sect. vi.

to the mean sun, should always be equal to each other, and one be just the same measure of the annual revolution in terms of the mean sidereal day as the other in terms of the mean solar[g].

It follows from this state of the case that, though astronomers usually obtain the length of the mean sidereal day in terms of the mean solar and *vice versa* in a different way and by an indirect process[h]; it must be possible to obtain either at once in terms of the other, from this double expression of one and the same thing, the mean annual revolution, 365 d·24225 in the mean solar day, 366 d·24225 in the mean sidereal day. It is manifest that, if we divide 365·24225 by 366·24225, it must give us the length of the mean sidereal day in terms of the mean solar day; and if we divide 366 d·24225 by 365 d·24225 it must give us the length of the mean solar day in terms of the mean sidereal. This is confirmed by the matter of fact. The quotient of the former division, carried out sufficiently far, is

0 d·997 269 566 796 293 983

and that of the latter is

1 d·002 737 908 881 023 485.

The reduction of the former gives

23 h. 56 m. 4 sec·090 571 199 800 131 2

the length of the mean sidereal day in terms of the mean solar day, i. e. in mean solar time, according to any standard which was ever yet assumed for it by astronomers themselves[h]: that of the latter gives

24 h. 3 m. 56 sec·555 327 320 429 104

the length of the mean solar day in terms of the mean sidereal, i. e. in mean sidereal time, according to any standard which was ever assumed of that too. It makes no difference to the result in either case whether one tropical year in mean solar time be divided by one tropical year in mean sidereal time, and *vice versa*; or any number of tropical years. 25885 mean tropical years of our standard contain 9 454 295·64125 of mean solar time, and 9 480 180·64125 of mean sidereal time; and the former divided by the latter gives 0 d·997 269

g Fasti, iv. 148. note. Diss. xv. ch. xiii. sect. ix. Appendix, ch. i. ii.
h Pontécoulant, Précis d'Astronomie, i. 135—137.

566 796 293 983; the latter divided by the former gives 1 d·002 737 908 881 023 485, as before.

These explanations having been premised, the principle of the Tables which follow from the xlth to the xliiird will easily be understood.

		h.	m.	s.
The mean solar day	=	24	0	0
The mean sidereal in terms of the mean solar	=	23	56	4·090 571 199 800 131 2
Difference	=	0	3	55·909 428 800 199 868 8
The mean solar day in terms of the mean sidereal	=	24	3	56·555 327 320 429 104
In terms of itself ..	=	24		
Difference	=	0	3	56·555 327 320 429 104

This difference in the latter case we call the DIURNAL ACCELERATION of mean sidereal time on mean solar; because it measures the interval by which mean sidereal time in a properly regulated sidereal clock appears to gain every day on the point of mean noon or mean midnight, shewn by a duly regulated mean solar clock. And this same difference in the former case we call the DIURNAL ANTICIPATION of mean sidereal time on mean solar; because it is in fact the measure of the interval by which mean sidereal time, constantly reduced or equated to mean solar, instead of gaining on the point of mean noon or mean midnight, shewn by a good mean time clock, does in reality fall back upon it, and anticipate on it perpetually.

Now the rate of the mean diurnal acceleration being

3 m. 56 s.·555 327 320 429 104

that of the mean horary is

9 s.·856 471 971 684 546

that of the mean sexagesimal

In minutes is	0 s.·164 274 532 861 409 1
In seconds is	0 s.·002 737 908 881 023 485
In decimal parts of a second is	0 s.·000 273 790 888 102 348 5

On these data Tables xl–xli Part iii are constructed. And it is manifest that by means of these Tables a given amount of mean solar time is easily reducible to the corresponding amount of mean sidereal time. For every given amount of mean solar time contains the same amount of mean sidereal time, and the same in terms; and something more: one

mean solar day one mean sidereal day and an aliquot part of a day more; one mean solar hour one sidereal hour and an aliquot part of an hour more; and so on. This excess of mean solar time over mean sidereal of the same denomination, we may call the *complement* of mean solar in mean sidereal time. It is an excess shewn by these Tables in each instance; the addition of which to the given sum of mean solar time will convert it at once from the given amount of mean solar time into the corresponding amount of mean sidereal. Thus the sidereal complement of one mean solar day is 3 m. 56 s. ·555 327 320 429 104: and 24 h. + 3 m. 56 s · 555 327 320 429 104 is the mean solar day in the form of the mean sidereal. The sidereal complement of the mean solar hour is 9 s · 856 471 971 684 546; and 1 h. + 9 s · 856 471 971 684 546 is the mean solar hour in terms of the mean sidereal.

The reverse of this process, or the reduction of a given amount of mean sidereal time to the corresponding amount of mean solar, is commonly called the CORRECTION of mean sidereal time. For the elements of mean sidereal time are nominally the same as those of mean solar. Both are termed days, or hours, or minutes, or seconds, alike. And yet the former in each instance are in reality less than the latter. The reduction of the former to the latter therefore is so far a correction of it; especially as it is a change made in the *thing* without any alteration in the *name*.

Now this correction in the entire period of 24 sidereal hours is nothing more or less than what we have agreed to call the diurnal anticipation[h]. This anticipation subtracted from 24 sidereal hours reduces them at once to their equivalent value in mean solar hours:

h.	m.	s.
24	0	0·0
−	3	55·909 428 800 199 868 8
23	56	4·090 571 199 800 131 2

i. e. the mean sidereal day, or period of 24 mean sidereal hours, in terms of the mean solar day, or period of 24 mean solar hours.

Such being the stated amount of the correction of the mean sidereal period of 24 hours, that of the sidereal hour is

h P. 255.

9 s.· 829 559 533 341 661 2.

That of the minute is

0 s.· 163 825 992 222 361 02.

That of the second is

0 s.· 002 730 433 203 706 017.

That of the 10th of a second is

0 s.· 000 273 043 320 370 601 7.

These are consequently the elements of the rest of the above Tables, xlii, xliii, Part i–iii. And these furnish the *correction* of any amount of mean sidereal time, from one day to 365 days, from one hour to 24, from one minute to 60, from one second to 60, and so on; as the preceding do the complement of any amount of mean solar time similarly circumstanced.

SECTION XVIII. Table xliv.—*Complement of the equable year, Cyclical or Nabonassarian, in mean sidereal time, from one to* 7000 *years.*

Table xlv.—*Sum of mean sidereal time in the mean tropical year of the Fasti, from one to* 7000 *years.*

Table xlvi.—*Complement of the mean Julian year in mean sidereal time, from one to* 7000 *years.*

Table xlvii.—*Complement of the mean sidereal year of the Fasti in mean sidereal time, from one to* 7000 *years.*

The principle, (which has just been explained,) of the complement of mean solar time in terms of sidereal, is easily extended from one period of 24 hours of mean solar time and its component parts, to any number of such periods and their component parts. The equable solar year is one such complex of periods of 24 hours of mean solar time. The mean tropical year is another. The mean Julian is a third. The mean sidereal year is a fourth. The mean anomalistic year would be a fifth.

These four Tables (xliv–xlvii inclusive) supply the necessary data for the reduction of the sum of mean solar time in any of these four kinds of the mean solar year, from one to 7000 years respectively, to the corresponding amount of mean sidereal time; and that with no more trouble than merely the addition of the sidereal complement on the proposed sum of mean solar time to this sum itself.

We begin with the xlivth, the sidereal complement of the equable year, the nature of which is to consist of 365 periods of 24 hours of mean solar time perpetually. Now if there be an excess of 3 m. 56 s.· 555 327 320 429 104 of mean sidereal time in any one period of 24 hours of mean solar time, in every complex of 365 such periods there must be an excess of 23 h. 59 m. 2 s.· 694 471 956 622 96 of mean sidereal time; for 3 m. 56 s.· 555 327 320 429 104 × 365 =

23 h. 59m. 2 s.· 694 471 956 622 96 exactly.

This therefore is the proper complement of 365 equable solar days in mean sidereal time; the addition of which to 365 days of mean solar time will convert them at once into their equivalent amount in mean sidereal time,

365 sidereal days + 23 h. 59 m. 2 s.· 694 471 956 622 96 of another.

Required the sum of mean sidereal time, measured perpetually by the period of 24 mean sidereal hours, in 5808 equable years, from Mesore 10 Æra Cyc. 0–1 to Mesore 10 Æra Cyc. 5808–5809 Nab. 2549–2550.

TABLE xliv.

	yrs.		d.	h.	m.	s.
Complement of	5000	=	4996	16	24	32·359 783 114 8
	800	=	799	11	15	55·577 565 298 368
	8	=	7	23	52	21·555 775 652 983 68
Complement of	5808	=	5804	3	32	49·493 124 066 151 68

TABLE xxix.

	yrs.		d.	h.	m.	s.
Sum of m. time in	5000	=	1 825 000			
	800	=	292 000			
	8	=	2 920			
Sum of m. time in	5808	=	2 119 920	0	0	0
Complement of	5808	=	+ 5 804	3	32	49·493 124 066 151 68
Sum of sidereal time			2 125 724	3	32	49·493 124 066 151 68

With respect to Table xlv: the length of the mean solar day in terms of the mean sidereal obtained supra[1],

1d.· 002 737 908 881 023 485 multiplied by

86400 seconds (= 24 hours) gives

86636 s.· 555 327 320 429 104; i. e.

24 h. 3 m. 56 s.· 555 327 320 429 104

of mean sidereal time exactly. But even this is not the ab-

[1] P. 254.

solute measure of the mean solar day in terms of the mean sidereal; it is only a very close approximation to it. It cannot therefore be any difficulty that even this excess of

3 m. 56 s.·555 327 320 429 104

multiplied by 365·24225 does not amount to an entire period of 24 hours, only to one which differs from it by an inappreciable quantity; for 24 h. = 86400 seconds exactly;

236 s.·555 327 320 429 104 × 365·24225
= 86399 s.·999 999 999 996 910 444.

We assume then, (and we think, only justly,) that the true sidereal complement of this particular complex of mean solar time, 365·24225 mean solar days, is one mean sidereal period of 24 hours exactly. On this datum Table xlv is constructed to shew the sum of mean sidereal time in any number of tropical years of our standard, from one year to 7000. The difference between this and Table xxx, which shews the same thing in mean solar time, it will be seen on comparison, begins with one day; and is ever afterwards accumulated at the same rate of one day for every year.

		d.	h.
TABLE xlv.	Sum of mean sidereal time in 7000 tropical years	2 563 695	18
TABLE xxx.	Sum of mean solar time in 7000 tropical years	2 556 695	18
	Difference ..	7000·00	

With regard to Table xlvi:

		h.	m.	s.
TABLE xliv.—Sidereal complement of 365 d.	=	23	59	2·694 471 956 622 96
TABLE xli P. i.—Sid. comp. of 6 h.	=			59·138 831 830 107 276
Sid. comp. of 365 d. 6 h.	=	24	0	1·833 303 786 730 236

On which datum we have constructed this Table; assuming that the sidereal complement of one mean Julian year, 365 d. 6 h, is

1 d. 0 h. 0 m. 1 s·833 303 786 730 236.

Comparison of Table xliv *and* xlvi.

5844 equable years = 5840 Julian.

	years.		h.	m.	s.
TAB. xliv.—Comp. of	5000 =	4996	16	24	32·359 783 114 8
	800 =	799	11	15	55·577 565 298 368
	40 =	39	23	21	47·778 878 264 918 4
	4 =	3	23	56	10·777 887 826 491 84
Comp. of	5844 =	5840	2	58	26·494 114 504 578 24

TAB. xxix.

	years.	d.	h.	m.	s.
Sum of mean time in	5000 =	1 825 000			
	800 =	292 000			
	40 =	14 600			
	4 =	1 460			
Sum of m. t. in ..	5844 =	2 133 060			
Sid. comp. 5844 y. =		5 840	2	58	26·494 114 504 578 24
Sum of sidereal time ..		2 138 900	2	58	26·494 114 504 578 24

	years.	d.	h.	m.	s.
TAB. xlvi.—Sid. comp. on	5000 =	5000	2	32	46·518 933 651 180
	800 =	800	0	24	26·643 029 384 1888
	40 =	40	0	1	13·332 151 469 209 44
Sid. comp. on ..	5840 =	5840	2	58	26·494 114 504 578 24

TAB. xxxi.

	years.	d.	h.	m.	s.
Sum of mean time in	5000 =	1 826 250			
	800 =	292 200			
	40 =	14 610			
Sum of mean time in	5840 =	2 133 060			
Sid. comp. on ..	5840 =	5 840	2	58	26·494 114 504 578 24
Sum of sid. time in	5840 =	2 138 900	2	58	26·494 114 504 578 24

With respect to Table xlvii; the proper sidereal complement of our mean sidereal year is one day, *plus* the argument or element of Table iv, Part i, supra[k], the mean annual increment in right ascension, obtained from the division of the period of 24 mean sidereal hours, or 86400 mean sidereal seconds, by 25884[l]; i. e.

3 s · 337 969 401 947 148 8178.

Required the sum of mean sidereal time in 5804 *mean sidereal years.*

TAB. xlvii.

	years.	d.	h.	m.	s.	
Sid. comp. of	5000 =	5000	4	38	9·847	
of	800 =	800	0	44	30·376	
	4 =	4	0	0	13·352	
Sid. comp. of	5804 =	5 804	5	22	53·575	
Sum of m. t. in	5804 =	2 119 947	22	1	29·508	Supra 246.
Sum of m. sid. t.	=	2 125 752	3	24	23·083	

It appears supra (p. 246) that the sidereal Precession on 5804 mean tropical years = 81 d. 21 h. 34 m. 7 s · 908. The sidereal epact, Tab. xlvii, on the last complete day in the

k P. 201. l Fasti, iii. 147, 148 note. Diss. xv. ch. xiii. sect. ix.

sum of the complement of these 5804 years is 5 h. 22 m. 53 s · 575. And this should be the sidereal complement of that Precession. We may easily put that to the test.

			d.		h. m. s.
Tab. xl.		Comp. on	60	=	3 56 33·319 639
		—	21	=	1 22 47·661 874
Tab. xli. P. i.		—	21 h.	=	3 26·985 911
	ii.	—	34 m.	=	5·585 334
	iii.	—	7 s.	=	0·019 165
	—	—	·9	=	0·002 464
	—	—	·008	=	0·000 022
Sid. comp. of 81 d. 21 h. 34 m. 7·908 sec. =					5 22 53·574 409

Section XIX.—*On the Equation of the Tables of mean motion in longitude to the Tables of mean sidereal time; and on the Epoch of Origination of the mean sidereal time of the Fasti; and on the Epochs of Table* xliv *and Table* xlvi *of mean sidereal time.*

Mean motion in longitude, as predicable of the sun, and mean sidereal time, are convertible terms; so that (as astronomers appear to be agreed[m]) the former divided by 15 will give the latter perpetually[n], and the latter multiplied by 15 will give the former. Thus,

3 m. 56 s · 555 327 320 429 104 × 15 = 59′ 8″ · 329 909 806 436 56,

the mean diurnal motion in longitude[o]; and

59′ 8″ · 329 909 806 436 56 divided by 15 = 3 m. 56 s · 555 327 320 429 104,

the mean diurnal acceleration[p]. The mean horary motion in longitude[o], 2′ · 464 117 992 921 136 5 or

2′ 27″ · 847 079 575 268 19, divided by 15, gives

9 s · 856 471 971 684 546 the mean horary acceleration[p]; and

9 s · 856 471 971 684 546, multiplied by 15, gives

2′ 27″ · 847 079 575 268 19

the mean horary motion in longitude.

It follows that our Tables of mean solar longitude (ix and x) are or should be critically adapted to our Tables of mean sidereal time (xliv and xlvi). And we have only to compare them together to see that they are. Tab. ix and x[q], 5844 equable years, or 5840 mean Julian, exclusive of entire revo-

m Explanations of the Nautical Almanac.

n See Table xxvi, P. ii, supra, 229.

o Table vii, P. i, p. 206.

p Table xl, p. 255.

q P. 219.

lutions, = 44° 36′ 37″·411 717 568 673 6: Tab. xliv and xlvi[r] 5844 equable years, and 5840 mean Julian, in mean sidereal time, exclusive of entire periods of 24 hours = 2 h. 58 m. 26 s · 494 114 504 578 24. And the former of these, divided by 15 = the latter; the latter, multiplied by 15 = the former.

It follows that the epoch of the mean longitude of our Tables is that of the mean sidereal time also; and the epoch of both is that of our Solar Cycle, the mean vernal ingress perpetually, first for the meridian of Jerusalem, and through that for any other. We propose to illustrate this by calculating the mean sidereal time of April 25 at midnight A. M. 5805 A. D. 1801, and that of Mesore 10 (Nab.) Æra Cyc. 5808–5809, both from these two Tables xliv and xlvi respectively, and from the mean vernal ingress A. M. 5805 A. D. 1801.

The mean vernal equinox A. D. 1801, from that of our Tables corrected, we have seen was March 11 0 h. 27 m. 21 s·6. We shall first of all then get the sidereal time of midnight, March 11, by subtracting from this epoch the sidereal complement of 0 h. 27 m. 21 s · 6.

i. TABLE xli. P. ii, iii.

Sid. comp. of		27 m.	=	4 s · 435 412 387 258 045 7
—	—	21 s.	=	0 · 057 496 086 501 493 185
—	—	·6	=	0 · 001 642 745 328 614 091
Sid. comp. of 27 m. 21·6 s.			=	4 · 494 551 219 088 152 976

						Mean sidereal time.			
		h.	m.	s.		h.	m.	s.	
ii.	March 11	0	27	21·6	=	0	0	0	
	–		27	21·6	=			– 4 · 494 551 219 088 152 976	
	March 11	0	0	0	=	23	59	55 · 505 448 780 911 847 024	
TAB. xl.	— 30					+ 1	58	16 · 659 819 612 873 12	
—	— 15					+	59	8 · 329 909 806 436 56	
	April 25	0	0	0	= 1 d.	2	57	20 · 495 178 200 221 527 024	
TAB. xl.	9					+	35	28 · 997 945 883 861 936	
	May 4	0	0	0	= 1 d.	3	32	49 · 493 124 084 083 463 024	
Sup. p. 258. Sidereal time of Mesore 10 Æra Cyc. 5808–5809						3	32	49 · 493 124 066 151 68	
						0	0	0 · 000 000 017 931 783 024	

[r] P. 259, 260.

Tab. xlvi.	yrs.		h.	m.	s.
Sid. comp. of	5000	=	2	32	46·518 933 651 18
	800	=		24	26·643 029 384 188 8
	4	=			7·333 215 146 920 944
Sid. comp. of	5804	=	2	57	20·495 178 182 289 744

		h.	m.	s.	
A. M. 1.	April 25	0	0	0	Midnight. Sid. time.
5804 =	+	2	57	20·495 178 182 289 744	
A. M. 5805.	April 25	2	57	20·495 178 182 289 744	
From the Mean V. E.		2	57	20·495 178 200 221 527 024	
		0	0	0·000 000 017 931 783 024	

These examples then prove that the epoch of the mean longitude of our Tables is also that of the mean sidereal time; and the epoch of both is the mean vernal ingress perpetually. It is clear too in this case, as much as in the parallel one of the mean longitude[s], that the mean sidereal time of April 25 at midnight, A. M. 5805 A. D. 1801, reckoned from the mean vernal equinox A. M. 5805 A. D. 1801, is the same as that of April 25 at midnight brought down without any change from April 25 at midnight A. M. 1 B. C. 4004; but it is one day's mean sidereal time greater than that of April 24 at midnight, reckoned from the mean vernal equinox A. D. 1801 also. Consequently it is clear, in this case as much as in the former, that the epoch of origination of the entire succession of mean sidereal time from a fixed Julian epoch, such as we exhibit in this xlvith Table, has dropped from April 25 at midnight to April 24 at midnight, and the mean sidereal time of the Table has dropped with it in the same proportion; somewhere between the epoch of the Table A. M. 1 and its proper epoch A. M. 5805.

The mean sidereal time of April 25 or April 24 at a given time A. D. 1801, thus obtained from our Tables, is not indeed exactly the same which would be shewn, for the same day and the same time of the day and the same meridian, by the modern Tables. But it differs only *per accidens* from it; and it is easy to get the mean sidereal time even of the most accurate modern tables, for any epoch which may be proposed, from

[s] Supra, 217.

that of our Tables. And as this is a point which is both curious and interesting, and highly important in confirmation of that prerogative which we claim for our Tables, as the true representation of mean equinoctial and of mean sidereal time for one meridian, and that the Primary meridian, from the first; it deserves to be illustrated here by one example of the fact at least: though for the more complete exemplification of it we refer to our General Work[t].

Let it be proposed then to compare the mean sidereal time of April 24 old style = May 6 new style, at mean noon, A.D. 1801 for the meridian of Greenwich, according to our Tables, with that of the same day and the same time of the day and for the same meridian according to Bessel.

The mean motion in longitude of one day according to the standard of Bessel is 0° 59′ 8″·330 22: and the mean sidereal time of one day (the diurnal acceleration) is 3 m. 56 sec·555 348. The former divided by 15 gives the latter; and the latter multiplied by 15 gives the former. Consequently 125 days' acceleration of this standard = 8 h. 12 m. 49 sec·418 5 of mean sidereal time.

Now the mean longitude of Jan. 1 mean noon, for the meridian of Greenwich, A. D. 1801, according to Bessel was 280° 39′ 13″·17[u]: and this being divided by 15 gives the mean sidereal time of the same epoch, 18 h. 42 m. 36 sec·878. We have then A. D. 1801 mean sidereal time,

		h.	m.	s.	
	Jan 1. m. n.	18	42	36·878	meridian of Greenwich.
	125 =	8	12	49·418 5	
May 6 =	Apr. 24. m. n.	2	55	26·296 5	

The first thing to be done, in order to the equation of the mean sidereal time of our own Tables to this, is to equate the mean equinoctial time of our Tables to that of Delambre's solar Tables. The standard of Delambre is 365 d·242264. That of our Fasti is 365 d·24 225. The difference of standards is consequently 0 d.000014: and in 5804 years this = 1 h. 57 m. 0 sec·518 4.

[t] Vol. iv. Appendix, ch. i. [u] Tables and Formulæ, 270.

We have then A. D. 1801—

		h.	m.	s.	
i. M.V.E. of the Tables	Mar. 11.	0	27	21·6	at Jerusalem.
od·000 014 × 5804	+	1	57	0·518 4	
	Mar. 11.	2	24	22·118 4	{ Equinox of the Tables equated to Delambre's.
	+	9	35	37·881 6	
	Mar. 11.	12	0	0·0	

ii. TABLE xli. P. i—iii.

	h.	m.	s.		m.	s.
Sid. Com.	9	0	0	=	1	28·708 248
		35	0	=		5·749 609
			37	=		0·101 303
			·8	=		0·002 190
			·08	=		0·000 219
			·002	=		0·000 005
Sid. Com.	9 h.	35 m.	37 1·882	=	1	34·561 574

Mean sidereal time.

		h.	m.	s.		h.	m.	s.	
iii.	March 11.	2	24	22·1184	=	0	0	0·0	at Jerusalem.
	+	9	35	37·882		+	1	34·561 574	
	March 11.	12	0	0·0		0	1	34·561 574	at Jerusalem.
	Meridians, in mean Sid. t.						+	23·127 116	
	March 11.	12			=	0	1	57·688 690	at Greenwich.
	Table xl. +	30.	—		=	1	58	16·659 820	
	— +	14.	—				55	11·774 582	
	April 24.	12			=	2	55	26·123 092	

Now it appears from Mr. Baily[x] that the mean longitude of Delambre Jan. 1 mean noon A. D. 1801 was 2″·65 less than that of Bessel at the same time. In mean sidereal time this = 2″·65 divided by 15, i. e. 0 s·176 666. It may be assumed that this difference would still be the same 125 days after, May 6 (= April 24) mean noon.

We have then, by the above,

		h.	m.	s.	
Mean Sid. Time	April 24. m. n.	2	55	26·123 092	Delambre.
			+	0·176 666	
Mean Sid. Time	April 24. m. n.	2	55	26·299 758	Bessel.
Bessel, supra,	—	2	55	26·296 5	
Difference		0	0	0·003 258	

And this difference, slight as it is, admits of explanation, though we cannot conveniently enter on the explanation of it here[y].

x Tables and Formulæ, 270.

y Cf. however vol. iv. Appendix, ch. i.

The true zero or epoch of mean longitude, of mean right ascension, of mean equinoctial time, of mean solar time, and of mean sidereal time, is consequently that of our Tables; but for one meridian only first and properly, the primary meridian, the meridian of the ancient Jerusalem[z]: for any other, secondarily and through that. And we again recommend this point to the careful consideration of all astronomers; hoping that they will not allow themselves to prejudge it, antecedent to all inquiry and examination, merely because it is brought under their notice by one who is no astronomer himself. For nothing can exceed the importance of this point, if true, even to their own science. The Problem of the Longitude itself must be solvable by means of it, if it admits of solution at all; if it is not an impossible Problem *per se*: for among the first and most indispensable conditions of the solution of such a Problem, the epoch of origination of mean solar time, the epoch of origination of mean sidereal time, and the primary meridian, must demand a place; and not one of these hitherto has been known.

It follows however from these premises that this xlvith Table (the Julian Table of mean sidereal time) is not more necessary for any practical use and application than the xth (the Julian Table of mean Longitude.) Nothing is wanted but division B of our Fasti Catholici perpetually. We have retained it however for the same reason as Table x. Both Tables in fact are the same thing in a different form and shape. It remains only to say something of the proper epoch both of this xlvith Table and of the xlivth, whether in coming down from B.C. 4004 or in going back from A.D. 1801.

We have provided this xlvith Table, as we did the xth, with a fourfold epoch, both for coming down and for going back, and both from midnight and from noon, and both for the meridian of Jerusalem and for that of Greenwich.

		h.	m.	s.
i. A. M. 1 B. C. 4004, mean Sidereal Time. Meri- of Jer. mean midnight.	April 25.	0	0	0
——At Greenwich	April 25.	0	0	23·127 116 318 005 377 795
Meridian of Jer. at mean noon.	April 25.	0	1	58·277 663 660 214 552
Meridian of Greenwich	April 25.	0	2	21·404 779 978 219 929 795

[z] Vol. ii. 58. Diss. ix. ch. iii.

		h.	m.	s.
ii. A.M. 5805 A.D. 1801 merid. of Jerusalem, m. Sid. T. mean midn.	April 24.	2	53	23·939 850 861 860 64
Meridian of Greenwich	April 24.	2	53	47·066 967 179 866 017 795
Meridian of Jerusalem, mean noon.	April 24.	2	55	22·217 514 522 075 192
Meridian of Greenwich	April 24.	2	55	45·344 630 840 080 569 795

The Epoch of Table xliv, Mesore 10 Æra Cyc. 0—1 = April 25 A. M. 1 B. C. 4004, is the same as that of Table xlvi for either meridian. Æra Cyc. 5808—5809, Nab. 2549—2550 Mesore 10 (Nab.) corresponded to May 4 O. S. May 16 N. S. A. M. 5805 A. D. 1801. The epoch of this Table then in going back is 10 days' mean sidereal time later than that of Table xlvi, for either meridian.

Mesore 10 Nab. 2549—2550=May 4 A. D. 1801.

		h.	m.	s.
Mean Sid. T. midn. meridian of Jerusalem	Mesore 10.	3	32	49·493 124 066 151 68
Meridian of Greenwich	Mesore 10.	3	33	12·620 240 384 157 057 795
Mean Sid. T. m. noon, meridian of Jer.	Mesore 10.	3	34	47·770 787 726 366 232
Meridian of Greenwich	Mesore 10.	3	35	10·897 904 044 371 609 795

SECTION XX. Table xlviii.—*Increment or Decrement of the obliquity of the Ecliptic, from one to* 7000 *mean Julian years.*

In this Table it is assumed (according to Bessel) that the annual increment of the obliquity (in going back from the epoch) or the annual decrement (in going forward from it) is $0''\cdot457$, subject to a secular correction of $\mp 0''\cdot 000\,544\,6 \times \kappa$ in each instance; in which κ stands for the number of centuries before or after the epoch of the Table. This epoch is the fixed equinox of A. D. 1750; and the obliquity of that epoch, according to Bessel also, is assumed at

$$23^\circ\ 28'\ 17''\cdot 65.$$

The secular correction is *negative* in going back from this epoch, *positive* in going forward; i. e. it must be subtracted from the increment found from the Table, in the former case, and added to the decrement found from it in the latter. The remainder or sum must be applied (with a *positive* sign in going back, with a *negative* in going forward, from A. D. 1750) to the obliquity of the epoch, $23^\circ\ 28'\ 17''\cdot 65$.

SECTION XXI. Table xlix. Part i.—*Lunar elements of the Phœnix Period. Mean diurnal motion in longitude, from one mean solar day to* 365.

Part ii.—*Lunar elements of the Phœnix Period. Mean horary motion in longitude, from one hour of mean solar time to* 24.

Part iii.—*Lunar elements of the Phœnix Period. Mean sexagesimal motion in longitude, from one minute of mean solar time to* 60.

Part iv.—*Lunar elements of the Phœnix Period. Mean sexagesimal motion in longitude, from one second of mean solar time to* 60*; and in decimal parts of one second of mean solar time.*

Table l.—*Lunar elements of the Phœnix Period. Mean motion of the Moon in longitude according to the Phœnix standard, from one mean Tropical year of the Fasti to* 7000.

Table li.—*Lunar elements of the Phœnix Period. Mean motion of the Moon in longitude according to the Phœnix standard, from one mean Julian year to* 7000.

Table lii.—*Lunar elements of the Phœnix Period. Sum of mean solar time in the Phœnix month, from one to* 13 *months of the Phœnix standard.*

With respect to these Tables, which are all entitled "Lunar Elements of the Phœnix Period," we necessarily refer our readers to vol. iii. 499–551, Diss. xv. ch. ix. of our General work. In fact to the whole of that Dissertation.

SECTION XXII. Table liii.—*Cycle of the Dominical or Sunday Letter in the Julian year.*

Table liv.—*Intervals, from the first day of any one month to the first of any other, in the Julian year, whether of* 365 *or of* 366 *days.*

These Tables require no explanation.

CHAPTER II.

Examples of the use of the Tables.

SECTION I.—*Equation of the centre.*

i. Calculation of the Equation of the centre (E) at the V. E. A.D. 1800; from the Tables of the Fasti and the solar Tables of Delambre of A. D. 1810.

Vernal Equinox B.C. 4004—Vernal Equinox A. D. 1800 = 5803 mean tropical years.

	yrs.		° ′ ″		° ′ ″
i. Table v, P. i.	5000	=	85 44 7·705		
	800	=	13 43 3·633		
	3	=	3 5·189		
AL	(5803)	=	99 30 16·527	=	99 30 16·5

			° ′ ″	
ii.	SL	=	360 0 0·0	Mean V. E. A.D. 1800
	− AL	=	−99 30 16·5	

		s. ° ′ ″	
SL−AL = SA = 260 29 43·5	=	8 20 29 43·5	From apogee.
		2 20 29 43·5	From perigee.
	or	2 20 29 ·725	From perigee.

iii. Delambre, A. D. 1810.

		s. ° ′		° ′ ″	
SA	=	2 20 20	=	1 53 26·2	Diff. + 2·9
		9·725	=	+ 2·8	Sec. var. + 17·05 × 0·1 = 1″·7
SA	=	2 20 29·725	=	1 53 29·0	
Sec. corr.		0·1.C.	=	+ 1·7	
A. D. 1800		E.	=	+ 1 53 30·7	

iv. Table viii, P. i and ii.

	° ′ ″		d. h. m. s.
	1 0 0	=	1 0 20 58·140
	53 0	=	21 30 31·380
	30	=	12 10·484
	·7	=	17·045
E =	+ 1 53 30·7	=	− 1 22 3 57·049
Supplement to N. Alm. 1828, Page viii. Equation of the centre, A. D. 1800, 1d·92		=	− 1 22 4 48
Difference			− 50·951

ii. Calculation of the Equation of the centre (E) at the

A. E. A. D. 1800, from the Tables of the Fasti and the solar Tables of Delambre.

i. M. V. E. A. D. 1800	A L	=	99° 30′ 16″·527
Table i, 182 d. 15 h.			+ 30·865 Table v, Part ii.
M. A. E.	A L	=	99 30 47·392 = 99° 30′ 47″·4

ii. M. V. E.	S L	=	180° 0′ 0″
	− A L	=	99 30 47·4
	S L − A L = S A	=	80 29 12·6 = 2s. 20° 29′ 12″·6 From apogee.
			8 20 29 12·6 } From perigee.
			8 20 29·21 } From perigee.

iii. Delambre, A. D. 1810.

S A − 8s. 20° 20′	=	11s. 28° 5′ 52″·0	Diff. − 3″·8
9·21	=	− 3·5	Sec. var. − 16″·82 × 0·1 = − 1″·7
S A = 8 20 29·21	=	11 28 5 48·5	
	=	0 1 54 11·5	
Sec. var.	=	− 1·7	
A. D. 1800. E	=	− 1 54 9·8	

iv. Table viii, Part i and ii.

1° 0′ 0″	=	1d. 0h. 20m. 58s·140
54 0	=	21 54 52·320
9	=	3 39·145
·8	=	19·480
E = − 1 54 9·8	=	+ 1 22 19 49·085
Supplement to N. A. loc. cit. E = 1d·93	=	+ 1 22 19 12
		+ 37·085

SECTION II.—*Calculation of solar Ingresses, from the Tables of the Fasti equated to those of Delambre.*

i. Calculation of the A. E. A. D. 882, for the meridian of Raccah. See the Fasti Catholici, ii. 467. Diss. xii. ch. iv. sect. vii. Cf. the Memoir of Mons. Biot (Mémoires de l'Académie des Sciences de l'Institut, xxii. 345. § 92: also, Mémoires de l'Académie Royale des Sciences, ann. 1782: Mémoire sur la durée de l'année solaire, par M. De La Lande, p. 252.)

Mean Vernal Equinox B. C. 4004 to Mean Autumnal Equinox A. D. 882 = 4885·5 mean tropical years.

A L 4885·5 yrs. = 83° 46′ 19″·7 Table v, P. i and ii.
S A (A. E.) = 9s. 6° 13′·67 From Perigee.
E = − 1° 53′ 6″·0
= + 1d 21h 53m 55s·617 Table viii, P. i and ii.
Equation of time = ± 7m 32s·4

		h.	m.	s.	
A. D. 882. Tab. m. V. E.	March 16	9	12	14·4	
Correction,	+ 2	0	11	9·6	
True M. V. E.	March 18	9	23	24·0	at Jerusalem.
Two quarters, Tab. i.	+ 182	14	54	25·2	
Mean A. E.	Sept. 17	0	17	49·2	at Jerusalem.
			+ 14	34	
	Sept. 17	0	32	23·2	at Raccah.
4885·5 × od·000 014 =		+ 1	38	29·5	
Mean V. E. of Delambre	Sept. 17.	2	10	52·7	at Raccah.
E =	+ 1	21	53	55·6	
True A. E.	Sept. 19	0	4	48·3	mean time.
Equation of time			+ 7	32·4	
	Sept. 19	0	12	20·7	apparent time.
By observation	Sept. 19	1	15*		
Difference		− 1	2	39·3	

* This equinox of Albatagnius, Sept. 19 1 15 A. M. A. D. 882, comes surprisingly near to the truth. According to Mr. Biot (supra, lib. cit.), Mons. Largiteau calculated it from the Tables of Delambre, with the corrections of Bessel, and found it

		h.	m.	s.	
Sept.	18	22	49	8	true (apparent) time for the meridian of Paris.
		+ 2	25	59	
Sept.	19	1	15	7	at Raccah or Aracta.

We cannot but suspect that so close a coincidence must be resolvable ultimately more or less into something accidental. Our own calculation is 1 h. 2 m. 39 s. in defect. Were we however to take into account the difference between Delambre's standard of the mean tropical year and Bessel's, this would be materially diminished. This difference is od · 000 043 987, and that being multiplied by 898 (the number of years back from A. D. 1780 to A. D. 882) = 56 m. 52·8 s. We assume this year A. D. 1780 because in that year we believe there was no difference between the mean longitude of Delambre and that of Bessel. We had then by our calculation, from our Tables, equated to Delambre's,

		h.	m.	s.
True A. E. at Raccah, ...	Sept. 19.	0	12	20·7
Add for the difference of Bessel and Delambre 898 yrs.		+	56	52·8
	Sept. 19.	1	9	13·5

Which is only 5 m. 53 s·5 less than the above from Bessel.

ii. Calculation of the V. E. A.D. 883, for the meridian of Raccah.

Mean Vernal Equinox B. C. 4004—Mean Vernal Equinox A. D. 883 = 4886 mean tropical years.

Table v, P. i and ii,
A L, 4886 years = 83° 46′ 50″·5
S A (mean V.E.) = 3s 6° 13′·158 from perigee.
E = + 1° 56′ 21″·2
Table viii, P. i and ii = 1d 23h 13m 8s·609
Equation of time = ∓ 7m 45s·4

			h.	m.	s.	
A. D. 883.	Tab. mean V. E.	March 16	15	1	4·8	
	Correction	+ 2	0	11	9·6	
	True Mean V. E.	March 18	15	12	14·4	at Jerusalem.
			+	14	34	
		March 18	15	26	48·4	at Raccah.
	4886 × 0d·000 014 =	+	1	38	30·1	
	Mean V. E. of Delambre	March 18	17	5	18·5	at Raccah.
	E =	− 1	23	13	8·6	
	True V. E.	March 16	17	52	9·9	mean time.
	Equation of time			−7	45·4	
		March 16	17	44	24·5	apparent time.
A. D. 882.	Mean A. E.	Sept. 19	1	15	0·0	app. t. at Raccah.
	Interval from observation	+ 178	14	30		
A. D. 883.	V. E.	March 16	15	45	0	apparent time.
			+ 1	59	24·5	
		March 16	17	44	24·5	app. t. by calculation.

iii. Calculation of the Vernal Equinox A. D. 1079, for the meridian of Ispahan. See Introduction to the Tables, p. 72, note.

Mean Vernal Equinox B. C. 4004—Mean Vernal Equinox, A. D. 1079 = 5082 mean tropical years.

Table v, P. i. A L (5082 yrs.) = 87° 8′ 29″·527
S A (M. V. E.) = 3s. 2° 51′·508 from perigee.
E = + 1° 56′ 29″·5
Table viii, P. i, ii. − 1d. 23h 16m 30s·714
Equation of time = ∓ 7m 45s·96

			h.	m.	s.	
A. D. 1079.	Tab. Mean V. E.	March 15	2	33	43·2	
	Correction	+ 2	0	11	9·6	
	True Mean V. E.	March 17	2	44	52·8	at Jerusalem.

			h.	m.	s.	
True M. V. E.		March 17	2	44	52·8	at Jerusalem.
			+ 1	6	12	
		March 17	3	51	4·8	at Ispahan.
5082 × 0 d · 000 014	=		+ 1	42	27·2	
M. V. E. of Delambre		March 17	5	33	32·0	
E	=	− 1	23	16	30·714	
True V. E.		March 15	6	17	1·286	m. time.
				− 7	45·96	
		March 15	6	9	15·326	app. time.

iv. Calculation of the Vernal Equinox A. D. 1584, for the meridian of Paris; from the observations of Tycho Brahe. See the Mémoire of M. De La Lande, ut supra, p. 257.

Mean Vernal Equinox B. C. 4004—Mean Vernal Equinox A. D. 1584 = 5587 mean tropical years.

Table v, P. i.	A L (5587 yrs.)	=	95° 48′ 3″·0
	S A (M. V. E.)	=	2 s 24° 11′·95 from perigee.
		=	+ 1° 54′ 58″·2
Table viii, P. i, ii.		=	− 1 d 22 h 39 m. 27·6 sec.

			h.	m.	s.	
A. D. 1584. Tab. Mean V. E.		March 10	10	37	55·2	
Correction		+ 2	0	11	9·6	
True mean V. E.		March 12	10	49	4·8	at Jerusalem.
			− 2	11	25	
		March 12	8	37	39·8	at Paris.
5587 × 0d·000 014	=		+ 1	52	38·035	
Mean V. E. of Delambre		March 12	10	30	17·835	
E	=	− 1	22	39	27·6	
True V. E.		March 10	11	50	50·235	mean time.
La Lande, from Tycho Brahe		March 10	12	47		
				− 56	9·765	

v. Calculation of the Autumnal Equinox A. D. 1584, for the meridian of Paris.

Mean Vernal Equinox B.C. 4004—Mean Autumnal Equinox A. D. 1584 = 5587·5 mean tropical years.

Table v, P. i.	A L (5587·5)	=	95° 48′ 33″·8
	S A (M. A. E.)	=	8 s 24° 11′·4366 from perigee.
	E	=	− 1° 54′ 41″·7
Table viii, P. i, ii.		=	+ 1 d 22 h. 32 m. 45·834 sec.

		h.	m.	s.	
A. D. 1584. True Mean V. E.	March 12	10	49	4·8	at Jerusalem.
Table i, Two quarters.	+ 182	14	54	25·2	
Mean A. E.	Sept. 11	1	43	30·0	at Jerusalem.
	−	2	11	25	
	Sept. 10	23	32	5·0	at Paris.
5587·5 × od·000 014 =	+	1	52	38·64	
Mean A. E. of Delambre	Sept. 11	1	24	43·64	
E =	+ 1	22	32	45·834	
True A. E.	Sept. 12	23	57	29·474	mean time.
La Lande, from Tycho Brahe.	Sept. 12	23	12		
		+	45	29·474	

vi. Calculation of the Vernal Equinox for the meridian of Paris, A. D. 1588.

Mean Vernal Equinox B. C. 4004—Mean Vernal Equinox A. D. 1588 = 5591 mean tropical years.

Table v, P. i. A L (5591 yrs.) = 95° 52′ 9″·9
S A (M. V. E.) = 2s 24° 7′·835 from perigee.
E = + 1° 54′ 56″·8
Table viii, P. i, ii. = − 1d 22h 38m 53s·511

		h.	m.	s.	
A. D. 1588. Tab. mean V. E.	March 10	9	53	16·8	
Correction	+ 2	0	11	9·6	
True mean V. E.	March 12	10	4	26·4	at Jerusalem.
	−	2	11	25	
	March 12	7	53	1·4	at Paris.
5591 × od·000 014 =		1	52	42·874	
Mean V. E. of Delambre	March 12	9	45	44·274	
E =	− 1	22	38	53·511	
True V. E.	March 10	11	6	50·763	mean time.
La Lande, from Tycho Brahe	March 10	12	17		
		− 1	10	9·237	

vii. Calculation of the Autumnal Equinox for the meridian of Paris, A. D. 1588.

Mean Vernal Equinox B.C. 4004—Mean Autumnal Equinox A.D. 1588 = 5591·5 mean tropical years.

Table v, P. i. A L (5591·5 yrs.) = 95° 52′ 40″·7
S A (M. A. E.) = 8s 24° 7′·32 from perigee.
E = − 1° 54′ 41″·3
Table viii, P. i. ii. = + 1d 22h 32m 36s·094

			h.	m.	s.	
A.D. 1588. Mean V. E.		March 12	7	53	1·4	at Paris.
Tab. i, Two quarters,		+ 182	14	54	25·2	
Mean A. E.		Sept. 10	22	47	26·6	
5591·5 × od·000 014	=	+ 1		52	43·478	
Mean A. E. of Delambre		Sept. 11	0	40	10·078	
E	=	+ 1	22	32	36·094	
True A. E.		Sept. 12	23	12	46·172	mean time.
La Lande, from Tycho Brahe		Sept. 12	22	36		
				+ 36	46·172	

viii. Calculation of the Autumnal Equinox for the meridian of Paris, A. D. 1591.

Mean Vernal Equinox B.C. 4004—Mean Autumnal Equinox A.D. 1591 =5594·5 mean tropical years.

Table v, P. i. A L (5594·5) =95° 55′ 45″·9
S A (M. A. E.)=8s 24° 4′ 235 from perigee.
E =− 1° 54′ 41″·1
Table viii, P. i, 2. =+ 1d 22h 32m 31s·224

			h.	m.	s.	
A.D. 1591. Tab. V. E.		March 11	3	19	48·0	
Correction		+ 2	0	11	9·6	
True Mean V. E.		March 13	3	30	57·6	at Jerusalem.
Tab. i, Two quarters		+ 182	14	54	25·2	
Mean A. E.		Sept. 11	18	25	22·8	at Jerusalem.
		−	2	11	25	
		Sept. 11	16	13	57·8	at Paris.
5594·5 × od·000 014	=	+ 1		52	47·107	
Mean A. E. of Delambre		Sept. 11	18	6	44·907	
E =		+ 1	22	32	31·224	
True A. E.		Sept. 13	16	39	16·131	mean time.
La Lande, from Tycho Brahe		Sept. 13	16	57		
				− 17	43·869	

ix. Calculation of the Vernal Equinox for the meridian of Paris, A. D. 1594.

Mean Vernal Equinox B. C. 4004—Mean Vernal Equinox A. D. 1594 =5597 mean tropical years.

Table v, P. i. A L (5597 yrs.)=95° 58′ 20″·3
S A (M. V. E.) =2s 24° 1′·6616
E =+ 1° 54′ 54″·7
Table viii, P. i. ii. =− 1d 22h 38m 2s·377

		h. m. s.	
A. D. 1594.	Tab. V. E.	March 10 20 46 19·2	
	Correction	+ 2 0 11 9·6	
	True mean V. E.	March 12 20 57 28·8	at Jerusalem.
		− 2 11 25	
A. D. 1594.	Mean V. E.	March 12 18 46 3·8	at Paris.
5597 × od·000 014 =		+ 1 52 50·131	
	Mean V. E. of Delambre	March 12 20 38 53·931	
	E =	− 1 22 38 2·377	
	True V. E.	March 10 22 0 51·554	mean time.
	La Lande, from Tycho Brahe	March 10 23 25	
		− 1 24 8·446	

x. Calculation of the Autumnal Equinox for the meridian of Paris, A. D. 1594.

Mean Vernal Equinox B. C. 4004— Mean Autumnal Equinox A. D. 1594 = 5597·5 mean tropical years.

Table v, P. i.	A L (5597·5 yrs.)	= 95° 58′ 51″·1
	S A (M.A.E.)	= 8s 24° 1′·148 from perigee.
	E	= − 1° 54′ 40″·8
Table viii, P. i. ii.		= + 1d 22h 32m 23s·919

		h. m. s.	
A. D. 1594.	M. V. E.	March 12 18 46 3·8	at Paris.
	Table i, Two quarters	+ 182 14 54 25·2	
	Mean A. E.	Sept. 11 9 40 29·0	at Paris.
5597·5 × od·000 014 =		+ 1 52 50·736	
	Mean A. E. of Delambre	Sept. 11 11 33 19·736	
	E =	+ 1 22 32 23·919	
	True A. E.	Sept. 13 10 5 43·655	mean time.
	La Lande, from Tycho Brahe	Sept. 13 10 27	
		− 21 16·345	

SECTION III.—*Calculation of new or full moons from the Tables of the Fasti. Explanation of Symbols.* See Fasti, iii. 511. Diss. xv. ch. ix. sect. iv.

i. S L. Mean longitude of the sun at mean noon, in the year and month, and on the day, prescribed by the problem.

ii. M L. Mean longitude of the moon at mean noon in the year and month, and on the day, prescribed by the problem; corrected by the formula for the acceleration.

iii. S L′. Mean longitude of the sun at the instant of mean conjunction or of mean opposition, on the day prescribed. Arguments of SL′,

i. D. For the conjunction $= SL - ML$ or $ML - SL$.

For the opposition $= \overline{SL + 180^\circ} - ML$ or $ML - \overline{SL + 180^\circ}$.

ii. $T = D$, i. e. Mean horary motion of the moon in *time* corresponding to D.

iii. $D' = T$, i. e. Mean horary motion of the sun in *arc* corresponding to T.

iv. $T' = D'$, i. e. Mean horary motion of the moon in *time* corresponding to D′.

v. $D'' = T'$, i. e. Mean horary motion of the sun in *arc* corresponding to T′.

vi. $T'' = D''$, i. e. Mean horary motion of the moon in time corresponding to D″: and so on, through as many equations of $D''' = T''$, $T''' = D'''$, $D'''' = T'''$ &c. as may be necessary to produce a perfect equation of the sun's mean motion to the moon's at last.

Then if SL is greater than ML, we have (whether for the conjunction or for the opposition)

$$SL' = SL + (D' + D'' + D''' + D'''', \text{\&c.})$$

If SL is less than ML, we have (in either case) as before

$$SL' = SL - (D' + D'' + D''' + D'''', \text{\&c.})$$

iv. ML′. Mean longitude of the moon at the instant of the mean conjunction or of the mean opposition. Argument of ML′, SL′. For the conjunction, $ML' = SL'$. For the opposition, $ML' = SL' + 180^\circ$.

v. MT. Mean noon, on the day of the conjunction or of the opposition: a datum supplied by the terms of the problem.

vi. MT′. Mean noon, corrected for the true instant of mean conjunction or mean opposition. Arguments, SL, ML, MT, and the sum of the equations $\overline{T + T' + T'' + T'''}$, &c.

SL being greater than ML,

$$MT' = MT + (T + T' + T'' + T''', \text{\&c.})$$

SL being less than ML,
$MT' = MT - (T + T' + T'' + T'''$, &c.)

vii. AL. Mean longitude of the apogee of the solar orbit, reckoned from $0^\circ\ 0'\ 0''$ at the mean vernal equinox B. C. 4004 to the mean vernal equinox in the year prescribed; and from that to the instant of the mean conjunction or mean opposition on the day prescribed $= AL'$.

viii. PL. Mean longitude of the lunar perigee, at mean noon, in the year and month, and on the day, prescribed: corrected by the formula for acceleration.

ix. PL′. Mean longitude of the lunar perigee at the instant of mean conjunction or mean opposition: Arguments of PL′, PL and the sum of the equations $T + T' + T'' + T'''$, &c. in time, reduced to the mean motion of the lunar perigee in arc. If the mean conjunction or opposition is *before* mean noon, $PL' = PL - (T + T' + T'' + T'''$, &c.) so reduced. If the mean conjunction or opposition is *after* mean noon, $PL' = PL + (T + T' + T'' + T'''$, &c.) similarly reduced.

x. NL. Mean longitude of the moon's ascending node at mean noon, in the year and month, and on the day, prescribed; corrected by the formula for acceleration.

xi. NL′. Mean longitude of the moon's ascending node at the instant of mean conjunction or of mean opposition. Arguments of NL′, NL and the sum of the equations $T + T' + T'' + T'''$, &c. reduced to the mean horary motion of the node in arc. Then, if the instant of conjunction or of opposition is *before* mean noon, $NL' = NL + (T + T' + T'' + T'''$ &c.) so reduced. If after mean noon, $NL' = NL - (T + T' + T'' + T'''$, &c.) similarly reduced.

xii. SA. The sun's mean anomaly at the instant of mean conjunction or of mean opposition. Arguments, SL′ and AL′. $SA = SL' - AL'$.

xiii. MA. The moon's mean anomaly at the instant of mean conjunction or mean opposition. Arguments, ML′ and PL′. $MA = ML' - PL'$ from the lunar perigee, and $\overline{ML' - PL'} + 180^\circ$, from the lunar apogee.

xiv. ND. Mean distance of the sun from the node at the instant of mean conjunction or of mean opposition. Arguments, SL′ and NL′. ND = SL′ − NL′.

xv. Equations, $\pm E \pm E' \pm E'' \pm E'''$. i. E. Argument, SA. ii. E′. Argument, MA′; i. e. MA ± a correction = x. Argument of x, SA. iii. E″. Argument, SA − MA′ iv. E‴. Argument, ND.

xvi. MT′. Mean time of the mean conjunction or the mean opposition, corrected by the sum or difference of the equations $\overline{\pm E \pm E' \pm E'' \pm E'''}$.

xvii. MT″. MT′ corrected for the difference of meridians: + if *east* of Greenwich, − if *west*.

xviii. MT‴. MT″ corrected for the equation of time or the reduction of mean time to apparent, if necessary. Arguments of MT‴, SA, and the sun's true place at the conjunction or the opposition.

We do not consider it necessary to enter on any further explanation of the above particulars, except so far as regards the method of finding SL′ and ML′ (Art. iii. and iv.) from SL and ML.

SL and ML being both known from the Tables of the Fasti, if SL or SL + 180° = ML, then SL′ is simply = SL, and ML′ = SL′ for the conjunction, or SL′ + 180° for the opposition.

But if SL is not = to ML, it is either greater or less than ML. Let us begin with supposing it greater. Then SL − ML or $\overline{SL + 180°} - ML = D$. In this case, the moon will not come into conjunction with the sun, or come opposite to the sun, until she has described a space = D. She will describe that space with her proper mean motion in the time T. But while the moon is describing D in the time T, the sun too will move over a space with its proper motion also, = T. Let us call this space D′. When the moon then has described D, it cannot yet come into conjunction with the sun, or opposite to the sun, until it has also described D′. It will describe D′ in the time T′. But while the moon is describing D′ in the time T′, the sun too will describe an arc = T′ in time; i. e. the arc D″. Even after describing D′ then, the

moon cannot overtake the sun, or come opposite to the sun, without describing D''. It will describe D'' in the time T'': and while it is describing D'' in T'' the sun may still be describing an arc, $D'''=T''$; which the moon may have yet to describe even after describing D'', to overtake the sun, or to come opposite to the sun. In short, this process, it is manifest, must go on, through a number of successive equations,

$$T=D, D'=T, T'=D', D''=T', T''=D'', D'''=T'', T'''=D''' \text{\&c.}$$

until the last of these arcs, D', D'', D''', D'''', &c. described by the sun, with its proper motion, in these times, T, T', T'', T''', &c. respectively is less than the space which the moon will describe with its proper mean motion also in less than a second of mean time. In this case the equation of the two mean motions may be considered complete. But it will seldom require less than three or four of these equations to bring it about; and it may sometimes require five or six.

It is evident then that the actual mean longitude of the sun, at the instant of the mean conjunction or of the mean opposition, will be its longitude at mean noon, SL, or SL + 180°, increased by these several arcs, $D'+D''+D'''+D''''$, &c. i. e. $SL+(D'+D''+D'''+D''''$, &c.); and the time of the mean conjunction or mean opposition will be the time of mean noon, MT, increased by the time $T+(T'+T''+T'''+T''''$, &c.) The result is the same when ML is greater than SL, or SL + 180°; only it must be taken with a contrary sign. So that as a general rule, SL and ML, the sun's and the moon's mean longitude at mean noon both being known, if SL is greater than ML, the sun's mean longitude at the mean conjunction or mean opposition will be $SL+(D'+D''+D'''+D''''$, &c.); and the moon's will be equal to the sun's, or to the sun's + 180°; and the time of the mean conjunction or mean opposition will be $MT+(T+T'+T''+T'''$, &c.) If SL be less than ML, SL′ will be $= SL-(D'+D''+D'''+D''''$, &c.); and ML′ will be equal to SL′ or SL′ + 180°; and the time of mean conjunction or mean opposition will be $MT-(T+T'+T''+T'''+T''''$, &c.)

We shall now proceed to illustrate our Tables by some actual examples.

i. Calculation of the full moon, March 19 B. C. 721, for the meridian of the ancient Babylon. First year of the cycle of leap-year. Lunar epoch, April 29 at 12 h. A. D. 1804. Interval, 2524 mean Julian years. Secular correction, 25·21 centuries. Mean vernal equinox B. C. 4004 to mean vernal equinox B. C. 721, 3283 years.

Cf. The Fasti, ii. 411. Diss. xii. ch. ii. sect. ii.

ii. LUNAR ECLIPSES. I.

		h.	m.	s.	
i.	March 29	19	10	33·6	Tabular M. V. E. B. C. 721.
Correction ..	+	12	11	9·6	
	March 30	7	21	43·2	True M. V. E. at Jerusalem.
	−	2	20	47	
	March 30	5	0	56·2	At Greenwich.
	− 10	17	0	56·2	
	March 19	12	0	0·0	

		°	′	″		h.	m.	s.
SL	=	360	0	0·0	Mar. 30	5	0	56·2
Tab. vii. P. i–iv.		−10	33	19·007 538	−10	17	0	56·2
SL	=	349	26	40·992 462				
	+	180						
SL+180°	=	169	26	40·992	Mar. 19	12	0	0·0

ii. ML 2524 mean Julian years.

	yrs.		°	′	″
Tab. xiv. ..	2000	=	37	33	46·422
	500	=	99	23	26·606
	20	=	133	34	32·264
	4	=	170	42	54·453
	2524	=	81	14	39·745

		°	′	″		h.	m.	s.	
Epoch		72	32	51·407	April 29	12	0	0	A. D. 1804.
2524 yrs. =	−	81	14	39·745					−2524.
		351	18	11·662					
Corr. 25·21 C.	+	1	48	24·863					
		353	6	36·525	April 29	12	0	0	B. C. 721.
Tab. xi. P. i.	−	180	13	56·107	−41				
ML	=	172	52	40·418	Mar. 19	12	0	0	
−SL+180°	−	169	26	41·0					
iii. D	=	3	25	59·418	= 3° 25′ 59″·4				

		°	′	″				h.	m.	s.
Tab. xii. P. i, ii. D	=	3	25	59·4	=	T	=	6	15	11·891
D′	=	0	15	24·532	=	T′	=	0	28	3·980
D″	=		1	9·158	=	T″	=		2	5·967
D‴	=			5·173	=	T‴	=			9·422
D⁗	=			0·386	=	T⁗	=			0·703

	°	′	″		h.	m.	s.
D′ D″ D‴ D⁗ =	0	16	39·249	= T′ + T″ + T‴ + T⁗ =	0	30	20·072
				T =	+6	15	11·891
				T T′ T″ T‴ T⁗ =	6	45	31·963
				=	6	45	32

		°	′	″				h.	m.	s.
	SL =	349	26	41·0	v. MT =	March	19	12	0	0
	−(D′ D″ D‴ D⁗)	−0	16	39·2	−(T T′ T″ T‴ T⁗)		—	6	45	32
iii.	SL′ =	349	10	1·8	vi. MT′ =	March	19	5	14	28
		+ 180								
iv.	ML′ = SL′ + 180° =	169	10	1·8		March	19	5	14	28

vii. AL. 3283 mean tropical years.

	yrs.		°	′	″			h.	m.	s.	
Tab. v. P. i.	3000	=	51	26	28·623						
	200	=	3	25	45·908						
	80	=	1	22	18·363						
	3	=		3	5·189						
AL	3283	=	56	17	38·083	Mar.	30	5	0	56·2	B.C. 721.
Tab. v. P. ii.				−	1·859		− 11				
AL′		=	56	17	36·224	Mar.	19	5			

viii. PL. 2524 mean Julian years.

	yrs.		°	′	″			h.	m.	s.	
Tab. xvii.	2000	=	20	55	32·016						
	500	=	185	13	53·004						
	20	=	93	48	33·320						
	4	=	162	45	42·664						
	2524	=	102	43	41·004						
Epoch	..		42	45	2·028	Apr.	29	12	0	0	A.D. 1804.
2524 yrs.	=		−102	43	41·004						−2524.
			300	1	21·024						
Corr. 25·21 C	=		−6	41	20·892						
			293	20	0·132	Apr.	29	12	0	0	B.C. 721.
Tab. xv. P. i.	..		−4	34	3·292		−41				
	PL		288	45	56·840	Mar.	19	12	0	0	
Tab. xv. P. ii–iv.	..			−1	52·946			−6	45	32	
ix.	PL′ =		288	44	3·894	Mar.	19	5	14	28	

x. **NL. 2524 mean Julian years.**

```
               yrs.      °   ′   ″
Tab. xx.       2000 = 163  19   9·998
                500 = 310  49  47·500
                 20 =  26  49  59·500
                  4 =  77  21  59·900
               ----------------------
               2524 = 218  20  56·898
```

```
                       °   ′   ″                     h.  m.  s.
Epoch       ..       308  57  57·373  Apr. 29        12  0   0   A.D. 1804.
2524 yrs. =         +218  20  56·898                                 −2524.
                    ---------------
                     167  18  54·271
Corr. 25·21 C  =    − 1    6  21·342
                    --------------------------------------------------------
                     166  12  32·929  April 29       12  0   0   B.C. 721.
Tab. xviii. P. i.  = + 2  10  16.095     −41
                    --------------------------------------------------------
               NL =  168  22  49·024  Mar. 19        12  0   0
Tab. xviii. P. ii–iv.         +53·687               −6  45  32
                    --------------------------------------------------------
xi.           NL′ =  168  23  42·711  Mar. 19         5  14  28
```

```
                       °   ′   ″                     h.  m.  s.
             SL′ =   349  10   1.8    Mar. 19         5  14  28
            −AL′ =   −56  17  36·2
                    ---------------
xii.  SA = SL′ − AL′ = 292  52  25·6 = 9s. 22° 52′·426.
```

```
                       °   ′   ″
             ML′ =   169  10   1·8
            −PL′ =  −288  44   3·9
                    ---------------
xiii. MA = ML − PL′ = 240  25  57·9 = 8s. 0° 25′ 57″·9 From Per.
                                      2s. 0° 25′ 57″·9 From Apog.
```

```
                       °   ′   ″
             SL′ =   349  10   1·8
            −NL′ = − 168  23  42·7
                    ---------------
xiv. ND = SL′ − NL′ = 180  46  19·1 = 6s. 0° 46′·318
```

```
                                           °   ′   ″                h.  m.  s.
Tab. xxi. P. i.   E     Argt. SA         (9  22  52·426) = +    3  49  20
          P. ii, iii. E′ Argt. MA′       (2   1  52·849) = +    8  55  38·4
          P. iv.  E″    Argt. SA − MA′   (7  20  59·6)   = +        3  44·98
          P. v.   E‴    Argt. ND         (6   0  46·318) = +           3·08
          ----------------------------------------------------------------
xv.               E E′ E″ E‴                             = + 12  48  46·46
```

```
                               h.  m.  s.
MT′ = March 19                  5  14  28
E E E′ E‴      =             + 12  48  46·46
                             -------------
xvi.  MT″ = March 18         18   3  14·46  At Greenwich, mean time.
                             +  2  57  22
                             -------------
xvii. MT‴ = March 19         21   0  36·46  At Babylon, mean time.
Ptolemy, March 19            21  30
```

ii. Calculation of the full moon, March 8, B. C. 720, for the meridian of the ancient Babylon. Second year of the cycle of leap-year. Lunar epoch, April 29 at 12 h. A.D. 1801. Interval, 2520 mean Julian years. Secular correction, 25·2 centuries. Mean V. E. B. C. 4004 to mean V. E. B. C. 720, 3284 mean tropical years.

			h.	m.	s.	
Tabular M. V. E.	March	30	0	59	24·0	B. C. 720.
Correction, ..		+	12	11	9·6	
True M. V. E.	March	30	13	10	33·6	at Jerusalem.
		−	2	20	47	
	March	30	10	49	46·6	at Greenwich.
	—	21	22	49	46·6	
	March	8	12	0	0	

		°	′	″			h.	m.	s.	
	S L =	360	0	0	Mar. 30	10	49	46·6		B. C. 720.
Tab. vii. P. i–iv.		− 21	38	10·219	—	21	22	49	46·6	
i.	S L =	338	21	49·781	March 8	12				
		+ 180								
S L + 180°	=	158	21	49·781	March 8	12				

		°	′	″			h.	m.	s.	
M L, Epoch ..		31	13	1·811	April	29	12	0	0	A. D. 1801.
Tab. xiv. 2520 y.		−270	31	45·292						− 2520.
		120	41	16·519						
Correction 25·2 C = +		1	48	19·827						
		122	29	36·346	April	29	12	0	0	B. C. 720.
Tab. xi. P. i.		−325	10	21·404		− 52				
ii.	M L =	157	19	14·942	March	8	12			

		°	′	″
S L + 180°	=	158	21	49·8
− M L	= −	157	19	14·9
D	= +	1	2	34·9

		°	′	″				h.	m.	s.
Tab. xii. P. i. ii. D	=	1	2	34·9	=	T	=	1	53	59·321
D′	=	0	4	40·881	=	T′	=	0	8	31·608
D″	=		0	21·011	=	T″	=		0	38·270
D‴	=			1·571	=	T‴	=			2.862
D⁗	=			0·117	=	T⁗	=			0·213
D′ D″ D‴ D⁗	=	0	5	3·580		T′ T″ T‴ T⁗	=	0	9	12·953
						T	=	1	53	59·321
						T + T′ T″ T‴ T⁗	=	2	3	12·274
								2	3	12

		° ′ ″			h. m. s.	
	S L =	338 21 49·8	v. M T	= March 8	12 0 0	
	D′ D″ D‴ D⁗ =	+ 5 3·6	T T′ T″ T‴ T⁗ =		+ 2 3 12	
iii.	S L′ =	338 26 53·4	vi. M T′	= March 8	14 3 12	
		+ 180				
iv.	M L′ =	158 26 53·4		March 8	14 3 12	
		° ′ ″			h. m. s.	
	Tab. v. P. i. AL 3284 y. =	56 18 39·812		Mar. 30	10 49 46·6	B. C. 720
	P. ii.	− 3·696		—	21 21	
vii.	A L′	= 56 18 36·116		Mar. 8	13 49 46·6	
		° ′ ″			h. m. s.	
	P L, Epoch ..	280 39 4·766		April 29	12 0 0	A. D. 1801
	Tab. xvii. 2520 y.	− 299 57 58·340				− 2520
		340 41 6·426				
	Corr. 25·2 C =	− 6 41 2·247				
		334 0 4·179		April 29	12 0 0	B. C. 720
	Tab. xv. P. i.	− 5 47 34·907		— 52		
viii.	P L	= 328 12 29·272		March 8	12 0 0	
	Tab. xv. P. ii–iv.	+ 34·313			+ 2 3 12	
ix.	P L′	= 328 13 3·585		March 8	14 3 12	
		° ′ ″			h. m. s.	
	N L, Epoch ..	7 0 14·957		April 29	12 0 0	A. D. 1801
	Tab. xx. 2520 y.	+ 140 58 56·998				− 2520
		147 59 11·955				
	Corr. 25·2 C =	− 1 6 18·259				
		146 52 53·696		April 29	12 0 0	B. C. 721
	Tab. xviii. P. i.	+ 2 45 13·097		— 52		
x.	N L =	149 38 6·793		March 8	12 0 0	
	Tab. xviii. P. ii–iv.	− 16·309			+ 2 3 12	
xi.	N L′ =	149 37 50·484		March 8	14 3 12	

		° ′ ″		s. ° ′ ″	
	S L′ =	338 26 53·4		March 8 14 3 12 (h. m. s.)	
	− A L′ =	− 56 18 36.1			
xii.	S A =	282 8 17·3	=	9 12 8·288	
	M L′ =	158 26 53·4			
	− P L′ =	− 328 13 3·6			
xiii.	M A =	190 13 49·8	=	6 10 13 49·8	From P.
				0 10 13 49·8	From Ap.
	S L′ =	338 26 53·4			
	− N L′ =	− 149 37 50·5			
xiv.	N D =	188 49 2·9	=	6 8 49·048	

									h. m. s.
Tab. xxi. P. i.	E	Argt. SA	(9	12	8·288)	= +	4	4	15·85
— P. ii. iii.	E′	Argt. MA′	(0	11	46·346)	= +	2	8	42·7
— P. iv.	E″	Argt. SA − MA′	(9	0	22)	= +		4	58
— P. v.	E‴	Argt. N D	(6	8	49·048)	= +			28·45
xv.	E E′ E″ E‴					= +	6	18	25·0

			h.	m.	s.	
	M T′ =	March 8	14	3	12	
	E E E E =		+ 6	18	25	
xvi.	M T″ =	March 8	20	21	37	at Greenwich, mean time.
			+ 2	57	22	
xvii.	M T‴ =	March 8	23	18	59	at Babylon, mean time.
	Ptolemy,	March 9	0	0	0	

iii. Calculation of the full moon, Sept. 1 B.C. 720, for the meridian of the ancient Babylon.

Preceding calculation,		° ′ ″		h. m. s.	
S L	=	338 21 49·781	March 8	12 0 0	B.C. 720.
Tab. vii. P. i.	+	174 27 34·394	+ 177		
i. S L	=	152 49 24·175	Sept. 1	12 0 0	
	+	180			
S L + 180	=	332 49 24·175	Sept. 1	12	

Preceding calculation,		° ′ ″		h. m. s.	
M L	=	157 19 14·942	March 8	12 0 0	B.C. 720.
Tab. xi. P. i.	+	172 13 19·780	+ 177		
ii. M L	=	329 32 34·722	Sept. 1	12 0 0	
S L + 180°	=	332 49 24·175			
— M L	= −	329 32 34·722			
D	=	3 16 49·453	Sept. 1	12 h.	

	° ′ ″		h. m. s.
Tab. xii. P. i. ii. D	= 3 16 49·453 = T	=	5 58 30·196
D′	= 0 14 43·394 = T′	=	0 26 49·048
D″	= 1 6·081 = T″	=	2 0·363
D‴	= 4·943 = T‴	=	9·003
D⁗	= 0·369 = T⁗	=	0·671
D′′′′′	= 0·027 = T′′′′′	=	0·049
D′ D″ D‴ D⁗ D′′′′′	= 0 15 54·814	T′ T″ T‴ T⁗ T′′′′′	= 0 28 59·134
		T	= 5 58 30·196
		T T′ T″ T‴ T⁗ T′′′′′	= 6 27 29·330
			= 6 27 29

			°	′	″				h.	m.	s.
	SL	=	152	49	24·175	v. MT	=	Sept. 1	12	0	0
	$D'D''D'''D''''D'''''$	+		15	54·814	$TT'T''T'''T''''T'''''$	= +		6	27	29
iii.	SL′		153	5	18·989	vi. MT′	=	Sept. 1	18	27	29
		+	180								
iv.	ML′	=	333	5	18·989			Sept. 1	18	27	29

			°	′	″		h.	m.	s.
	AL	=	56	18	36·116	March 8	13	49	46·6
				+	29·949	+ 177	5		
vii.	AL′	=	56	19	6·065	Sept. 1	18	49	46·6

	PL	=	328	12	29·272	March 8	12	0	0
	Tab. xv. P. i.	+	19	43	6·893	+ 177			
viii.	PL	=	347	55	36·165	Sept. 1	12	0	0
	Tab. xv. P. ii–iv.		+	1	47·919	+	6	27	29
ix.	PL′	=	347	57	24·084	Sept. 1	18	27	29

	NL	=	149	38	6·793	March 8	12	0	0
	Tab. xviii. P. i.	−	9	22	22·657	+ 177			
x.	NL	=	140	15	44·136	Sept. 1	12	0	0
	Tab. xviii. P. ii–iv.			−	51·297	+	6	27	29
xi.	NL′	=	140	14	52·839	Sept. 1	18	27	29

			°	′	″			h.	m.	s.
	SL′	=	153	5	18·989	Sept. 1		18	27	29
	−AL′	=	−56	19	6·065					
							s.	°	′	
xii.	SA	=	96	46	12·924	=	3	6	46·2154	

							s.	°	′	″	
	ML′	=	333	5	18·989						
	−PL′	=	−347	57	24·084						
xii.	MA	=	345	7	54·905	=	11	15	7	54·905	From P.
							5	15	7	54·905	From Ap.
	SL′	=	153	5	18·989						
	−NL	=	−140	14	52·839						
							s.	°	′		
xiii.	ND	=	12	50	26·150	=	0	12	50·4358		

				s. ° ′ ″		h.	m.	s.
Tab. xxi.	P. i.	E	Argt. SA	(3 6 46·2154)	= −	4	9	44·7
—	P. ii. iii.	E′	Argt. MA′	(5 13 33·3261)	= +	2	34	30·7
—	P. iv.	E″	Argt. SA − MA′	(9 23 12·9)	= +		4	31·6
—	P. v.	E‴	Argt. ND	(0 12 50·4358)	= +			40·5
xiv.		EE′E″E‴			= −	1	30	1·9

					h.	m.	s.	
	M T	=	Sept.	1	18	27	29	
	E E' E'' E'''	=		—	1	30	1·9	
xv.	M T'	=	Sept	1	16	57	27·1	at Greenwich, mean time.
				+	2	57	22	
xvi.	M T''	=	Sept	1	19	54	49·1	at Babylon, mean time.
	Ptolemy,		Sept	1	20	30		

iv. Calculation of the new moon, March 22 A. D. 30, for the meridian of the ancient Jerusalem. Third year of the cycle of leap-year. Lunar Epoch, April 29, at 12h. A.D. 1802. Interval, 1772 mean Julian years. Secular correction, 17·71 centuries. Mean V. E. B.C. 4004 to mean V. E. A. D. 30, 4033 mean tropical years.

Cf. the Fasti, vol. i. 535. Diss. vi. App. Ch. i. Sect. iii: ii. 206. Diss. x. ch. v. Sect. viii.

			m.	h.	s.	
Tabular M. V. E.	March	22	23	40	33·6	A. D. 30.
Correction	+	2	0	11	9·6	
True M. V. E.	March	24	23	51	43·2	at Jerusalem.
		—	2	20	47	
	March	24	21	30	56·2	at Greenwich.
		—2	9	30	56·2	
	March	22	12	0	0·0	

			°	′	″			h.	m.	s.
	S L	=	360	0	0·0	March	24	21	30	56·2
	Tab. vii. P. i–iv.		—2	21	43·515	—	2	9	30	56·2
i.	S L	=	357	38	16·485	March	22	12		

		°	′	″			h.	m.	s.	
	M L, Epoch	160	36	6·667	April	29	12	0	0	A. D. 1802.
	Tab. xiv. 1772 y.	—26	48	2·610					—	1772.
		133	48	4·057						
		133	48	4·057	April	29	12	0	0	A. D. 30.
	Corr. 17·71 C.	+	54	15·725						
		134	42	19·782						
	Tab. xi. P. i.	—140	42	11·026	—	38				
ii.	M L =	354	0	8·756	March	22	12			

		°	′	″			
S L	=	357	38	16·485			
— M L	= —	354	0	8·756			
D	=	+3	38	7·729	March	22	12

Tab. xii. P. i. ii.	D =	° ′ ″ 3 38 7·729	= T =		h. m. s. 6 37 18·497
	D′ =	0 16 19·014	= T =		0 29 43·213
	D″ =	1 13·234	= T′ =		2 13·391
	D‴ =	5·478	= T″ =		9·979
	D⁗ =	0·409	= T‴ =		0·745
	D′ D″ D‴ D⁗ =	0 17 38·135	= T T′ T″ T‴		h. m. s. = 0 32 7·328
			T T T′ T″ T‴		= 7 9 25·825
					= 7 9 26

	S L. =	° 357 38 16·5	v. M T =	h. m. s. March 22 12 0 0
	D′ D″ D‴ D⁗ =	+0 17 38·135	T T′ T″ T‴	+ 7 9 26
iii.	S L′ =	357 55 54·6	vi. M T =	March 22 19 9 26
iv.	M L′ =	357 55 54·6		

vii.	A L, 4033 y. =	° ′ ″ 69 9 15·239	h. m. s. March 24 21 30 56·2
	Tab. v. P. i. ii.	— 0·352	— 2 2
vii.	A L′ =	69 9 14·887	March 22 19 30 56·2

	P L, Epoch	° ′ ″ 321 18 50·168	h. m. s. April 29 12 0 0 A. D. 1802.
	Tab. xvii. 1772 y.	− 103 30 0·167	— 1772.
		217 48 50·001	
	Corr. 17·71 C =	−3 20 52·638	
		214 27 57·363	April 29 12 0 0 A. D. 30.
	P L =	214 27 57·363	April 29 12 0 0 A. D. 30
	Tab. xv. P. i.	—4 14 0·124	— 38
viii.	P L =	210 13 57·239	Mar. 22 12 0 0
	Tab. xv. P. ii—iv.	+ 1 59·603	+ 7 9 26
ix.	P L′ =	210 15 56·842	Mar. 22 19 9 26

	N L, Epoch	° ′ ″ 347 40 32·642	h. m. s. April 30 12 0 0 A. D. 1802.
	Tab. xx. 1772 y.	+ 73 25 15·698	— 1772.
		61 5 48·340	
	Corr. 17·71 C.	− 33 12·687	
		60 32 35·653	April 29 12 0·0 A. D. 30.
	Tab. xviii. P. i.	+ 2 0 44·186	— 38
x.	N L =	62 33 19·839	Mar. 22 12 0·0
	xviii. P. ii—iv.	— 56·850	+ 7 9·26
xi.	N L′ =	62 32 22·989	Mar. 22 19 9·26

			° ′ ″	h. m. s.
	SL′	=	357 55 54·6	Mar. 22 19 9 26
	− AL′	=	−69 9 14·9	
xii.	SA	=	288 46 39·7	= 9 s. 18° 46′·66.

			° ′ ″	
	ML′	=	357 55 54·6	
	−PL′	=	−210 15 56·8	
				s. ° ′ ″
xiii.	MA	=	147 39 57·8	= 4 27 39 57·8 From Per.
				10 27 39 57·8 From Apog.

			° ′ ″	
	SL′	=	357 55 54·6	
	− NL′	=	− 62 32 23·0	
				s. ° ′
xiv.	ND	=	295 23 31·6	= 9 25 23·526

				h. m. s.
Tab. xxi. P. i. E	Argt. SA	(9 s. 18° 46′·66)	=	+ 3 55 54·3
P. ii—iii. E′	Argt. MA′	(10 s. 29° 9′·373)	=	− 5 20 30·4
iv. E″	Argt. SA—MA′	(10 s. 19′ 37″·3)	=	+ 3 3·5
v. E‴	Argt. ND	(9 s. 25° 23′·5)	=	− 1 14·8
xv. EE′E″E‴			=	− 1 22 47·4

				h. m. s.
	MT′	=	March 22	19 9 26
	EE′E″E‴	=		− 1 22 47·4
xvi.	MT″	=	March 22.	17 46 38·6 at Greenwich, mean time.
				+ 2 20 47
xvii.	MT‴	=	March 22	20 7 25·6 at Jerusalem, mean time.

v. Calculation of the full moon, April 6 A. D. 30, for the meridian of the ancient Jerusalem. Cf. Fasti, vol. i. 536. Diss. vi. App. Ch. i. Section iii.

			° ′ ″	h.
	SL	=	357 38 16·485	March 22 12
	Tab. vii. P. i.		+ 14 47 4·949	+ 15
i.	SL	=	12 25 21·434	April 6 12
			+ 180	
	SL + 180°	=	192 25 21·434	

			° ′ ″	h.
	ML	=	354 0 8·756	March 22. 12
	Tab. xi. P. i.		+ 197 38 45·405	+ 15.
ii.	ML	=	191 38 54·161	April 6. 12

		° ″ ′	
SL + 180°	=	192 25 21·434	April 6. 12
−ML	=	−191 38 54·161	
D =		+ 0 46 27·273	

		° ′ ″		h. m. s.
Tab. xii. P. ii.	D	0 46 27·273	$= T =$	1 24 36·847
	$D' =$	3 28·499	$= T' =$	6 19·768
	$D'' =$	15·596	$= T'' =$	28·408
	$D''' =$	1·166	$= T''' =$	2·123
	$D'''' =$	0·087	$= T'''' =$	0·159
	$D' D'' D''' D'''' =$	0 3 45·348	$= T\, T'\, T''\, T'''\, T'''' =$	1 31 27·305
			=	1 31 27

		° ′ ″			h. m. s.
	$SL =$	12 25 21·434	v. $MT =$	April 6	12 0 0
	$D' D'' D''' D'''' =$	+ 3 45·348	$T\, T'\, T''\, T'''\, T'''' =$	+	1 31 27
iii.	$SL' =$	12 29 6·782	vi. $MT' =$	April 6	13 31 27
		+ 180			
iv.	$ML' =$	192 29 6·782		April 6	13 31 27

		° ′ ″			h. m. s.
	$AL =$	69 9 15·239		March 24	21 30 56·2
	Tab. v. P. ii	+ 2·141	=	+	12 16
vii.	$AL' =$	69 9 17·380		April 6	13 30 56·2

		° ′ ″		h. m. s.
	$PL =$	210 13 57·239	March 22	21 0 0
	Tab. xv. P. i.	+ 1 40 15·838	+	15
viii.	$PL =$	211 54 13·077	April 6	12 0 0
	Tab. xv. P. ii–iv.	+ 25·470	+	1 31 27
ix.	$PL' =$	211 54 38·547	April 6	13 31 27

		° ′ ″		h. m. s.
	$NL' =$	62 33 19·839	March 22	12 0 0
	Tab. xviii. P. i.	− 47 39·547	+	15
x.	$NL =$	61 45 40·292	April 6	12 0 0
	Tab. xviii. P. ii–iv.	− 12·107	+	1 31 27
xi.	$NL' =$	61 45 28·185	April 6	13 31 27

		° ′ ″			h. m. s.
	$SL' =$	12 29 6·8		April 6	13 21 27
	$-AL' =$	−69 9 17·4			
xii.	$SA =$	303 19 49·4	=	10° 3′ 19″·823	

		° ′ ″		s. ° ′ ″
	$ML' =$	192 29 6·8		
	$-PL' =$	−211 54 38·5		
xiii.	$MA =$	340 34 28·3	=	11 10 34 28·3 From P.
				5 10 34 28·3 From Ap.

		° ′ ″		s. ° ′
	$SL' =$	12 29 6·8		
	$-NL' =$	−61 45 28·2		
xv.	$ND =$	310 43 38·6	=	10 10 43·64

			s. ° ′	h. m. s.
Tab. xxi. P. i.	E	Argt. S A	(10 3 19·823)	= +3 27 14·4
— ii, iii.	E′	Argt. M A′	(5 11 53·038)	= +2 49 42·2
— iv.	E″	Argt. S A—M A′	(4 21 26·8)	= – 2 56·2
— v.	E‴	Argt. N D	(10 10 43·6)	= – 1 33
xv.	E E′ E″ E‴			= +6 12 27·4

			h. m. s.	
	M T	=	April 6 13 31 27	
	E E′ E″ E‴	=	+ 6 12 27·4	
xvii.	M T′	=	April 6 19 43 54·4	at Greenwich, mean time.
			+ 2 20 47	
xvii.	M T″	=	April 6 22 4 41·4	at Jerusalem, mean time.

vi. Residue of the ecliptic full moons of the Magna Compositio, calculated from the Tables of the Fasti and compared with the dates of Ptolemy. See Fasti, ii. 411. Diss. xii. ch. ii. section ii. ii. Lunar Eclipses.

	B. C.	Meridian.	Ptolemy.	h.	m.	Tables of the Fasti.	h.	m.	s.	
iv	621	Babylon	April 22	5	50	April 22	4	27	27·2	M. T.
v	523	Babylon	July 16	23	0	July 16	23	11	42·5	—
vi	502	Babylon	Nov. 19	23	36	Nov. 19	23	28	7·1	—
vii	491	Babylon	April 25	23	30	April 25	22	7	48	—
viii	383	Babylon	Dec. 23	7	20	Dec. 23	7	26	18·6	—
ix	382	Babylon	June 18	21	6	June 18	20	44	9·8	—
x	382	Babylon	Dec. 12	23		Dec. 12	22	34	34·8	—
xi	201	Alexandria	Sept. 22	19		Sept. 22	18	40	7·2	—
xii	200	Alexandria	Mar. 20	1	20	Mar. 20	0	34	47·9	—
xiii	200	Alexandria	Sept. 12	2	15	Sept. 12	2	16	11·6	—
xiv	174	Alexandria	May 1	2	20	May 1	1	23	43·8	—
xv	141	Rhodes	Jan. 27	22	10	Jan. 27	21	30	26·6	—
xvi	A.D. 125	Alexandria	April 5	20	24	April 5	20	21	45·8	—
xvii	133	Alexandria	May 6	23	15	May 6	22	36	29·3	—
xviii	134	Alexandria	Oct. 20	23		Oct. 20	22	45	47·5	—
xix	136	Alexandria	Mar. 6	4		Mar. 6	3	12	42·2	—

SUPPLEMENTARY TABLES

OF THE

FASTI CATHOLICI.

*A

TABLE I.

Ingresses of the mean Sun into the twelve months of the mean tropical year, and of the Calendar of Mazzaroth.*

Mean Natural Year.							Calendar of Mazzaroth.	Common Years.			
Months.	Days.	H.	M.	S.	Th.	Degrees.		Days.	Sum of days.	D.	Leap-years.
i	0	*0	0	0	0	0	Krion	31	0		
ii	30	10	29	4	12	30	Tauron	30	31		
iii	60	20	58	8	24	60	Didymon	31	61		
iv	91	7	27	12	36	90	Karkinon	31	92		
v	121	17	56	16	48	120	Leonton	30	123		
vi	152	4	25	21		150	Parthenon	30	153		
vii	182	14	54	25	12	180	Zygon	30	183		
viii	213	1	23	29	24	210	Scorpion	31	213		
ix	243	11	52	33	36	240	Toxon	30	244		
x	273	22	21	37	48	270	Ægon	30	274		
xi	304	8	50	42		300	Hydron	30	304	31	
xii	334	19	19	46	12	330	Ichthyon	31	334	31	335
i	365	5	48	50	24	360	Krion		365		366

* The ingresses of the sun into the first month of the mean natural year are shewn in the Fasti Catholici (Division B) every year, for the meridian of Jerusalem. Those into the rest of the months take place at the distance of one mean month, or some multiple of one mean month, after in each instance; those distances being shewn by this Table.

TABLE II.

Lengths of the Four Quarters of the tropical year at the ingress of each Julian Period of the Fasti.

PART I.							PART II.					
						Difference.				Equation of the Centre.		Difference.
Period	A. M.	B. C.	Yrs.	Qr.	d. h. m. s.	h. m. s.	Period	Qr.	d. h. m. s.	° ′ ″	d. h. m. s.	h. m. s.
i	1	4004	112	i	93 13 1 25		i	i	92 23 50 50·158	+ 0 0 0·0	−0 0 0 0·0	
				ii	89 1 53			ii	89 15 22 12·684	− 1 39 32·2	+1 16 23 37·558	
				iii	89 1 53 1			iii	89 1 51 20·007	− 0 0 45·9	+0 0 18 37·642	
				iv	93 13 1 26			iv	93 12 44 27·551	+ 2 11 18·4	−2 5 17 14·951	
ii	113	3892	140	i	93 14 39 21	+ 1 37 56	ii	i	93 1 22 47·752	+ 0 3 33·8	−0 1 26 45·920	+ 1 26 45·920
				ii	89 3 49 56	+ 1 56 56		ii	89 16 39 28·828	− 1 39 44·9	+1 16 28 49·232	+ 0 5 11·674
				iii	89 0 15 5	− 1 37 56		iii	89 0 36 3·175	− 0 4 9·1	+0 1 41 5·460	+ 1 22 27·818
				iv	93 11 4 30	− 1 56 56		iv	93 11 10 30·645	+ 2 11 0·7	−2 5 10 3·965	− 0 7 10·986
iii	253	3752	112	i	93 16 35 42	+ 1 56 21	iii	i	93 3 35 34·911	+ 0 8 55·5	−0 3 37 19·157	+ 2 10 33·237
				ii	89 6 20 25	+ 2 30 29		ii	89 18 20 41·594	− 1 39 50·4	+1 16 31 3·154	+ 0 2 13·922
				iii	88 22 18 44	− 1 56 21		iii	88 23 6 34·080	− 0 8 24·0	+0 3 24 32·148	+ 1 43 26·688
				iv	93 8 34 1	− 2 30 29		iv	93 8 45 59·815	+ 2 10 26·3	−2 4 56 6·372	− 0 13 57·593
iv	365	3640	140	i	93 18 3 50	+ 1 28 8	iv	i	93 5 17 46·086	+ 0 13 10·1	−0 5 20 38·510	+ 1 43 19·353
				ii	89 8 23 49	+ 2 3 24		ii	89 19 44 56·519	− 1 39 47·6	+1 16 29 54·976	− 0 1 8·178
				iii	88 20 50 36	− 1 38 8		iii	88 21 58 35·600	− 0 11 48·8	+0 4 47 38·895	+ 1 23 6·747
				iv	93 6 30 37	− 2 3 24		iv	93 6 47 32·195	+ 2 9 49·0	−2 4 40 58·105	− 0 15 8·267
v	505	3500	112	i	93 19 47 48	+ 1 43 58	v	i	93 7 20 44·014	+ 0 18 26·3	−0 7 28 57·852	+ 2 8 19·342
				ii	89 11 1 47	+ 2 37 58		ii	89 21 34 35·785	− 1 39 34·4	+1 16 24 33·562	− 0 5 21·414
				iii	88 19 6 38	− 1 43 58		iii	88 20 38 14·339	− 0 16 5·8	+0 6 31 56·747	+ 1 44 17·852
				iv	93 3 52 39	− 2 37 58		iv	93 4 15 16·262	+ 2 8 50·0	−2 4 17 1·514	− 0 23 56·591
vi	617	3388	140	i	93 21 6 8	+ 1 28 20	vi	i	93 8 54 48·229	+ 0 22 35·8	−0 9 10 13·052	+ 1 41 15·200
				ii	89 13 10 49	+ 2 9 2		ii	89 23 5 27·606	− 1 39 16·7	+1 16 17 22·577	− 0 7 10·985
				iii	88 17 48 18	− 1 28 20		iii	88 19 37 48·759	− 0 19 32·0	+0 7 55 37·583	+ 1 23 40·836
				iv	93 1 43 37	− 2 9 2		iv	93 2 10 45·806	+ 2 7 52·7	−2 3 53 46·258	− 0 23 15·256
vii	757	3248	140	i	93 22 37 26	+ 1 31 18	vii	i	93 10 46 53·499	+ 0 27 44·5	−0 11 15 29·712	+ 2 5 16·660
				ii	89 15 55 15	+ 2 44 26		ii	90 1 2 54·383	− 1 38 44·2	+1 16 4 11·187	− 0 13 11·390
				iii	88 16 17	− 1 31 18		iii	88 18 27 14·350	− 0 23 48·9	+0 9 39 52·970	+ 1 44 15·387
				iv	92 22 59 11	− 2 44 26		iv	92 23 31 48·168	+ 2 6 29·7	−2 3 20 5·280	− 0 33 40·978

TABLE II.

PART I.							PART II.					
						Difference.				Equation of the Centre.		Difference.
Period	A. M.	B. C.	Yrs.	Qr.	d. h. m. s.	h. m. s.	Period	Qr.	d. h. m. s.	° ′ ″	d. h. m. s.	h. m. s.
viii	897	3108	112	i	94 0 1 23	+ 1 23 57	viii	i	93 12 32 43·820	+ 0 32 48·6	−0 13 18 54·365	+ 2 3 24·653
				ii	89 18 42 52	+ 2 47 37		ii	90 3 4 46·567	− 1 38 0·9	+1 15 46 36·855	− 0 17 34·332
				iii	88 14 53 3	− 1 23 57		iii	88 17 22 13·530	− 0 28 5·9	+0 11 24 10·822	+ 1 44 17·852
				iv	92 20 11 34	− 2 47 37		iv	92 20 49 6·483	+ 2 4 52·9	−2 2 40 48·248	− 0 39 17·032
ix	1009	2996	140	i	94 1 3 10	+ 1 1 47	ix	i	93 13 52 50·441	+ 0 36 48·1	−0 14 56 6·070	+ 1 37 11·705
				ii	89 20 59 6	+ 2 16 14		ii	90 4 44 53·529	− 1 37 18·8	+1 15 29 31·771	− 0 17 5·084
				iii	88 13 51 16	− 1 1 47		iii	88 16 34 27·653	− 0 31 30·5	+0 12 47 12·700	+ 1 23 1·878
				iv	92 17 55 20	− 2 16 14		iv	92 18 36 38·777	+ 2 3 26·0	−2 2 5 32·247	− 0 35 16·001
x	1149	2856	112	i	94 2 14 1	+ 1 10 51	x	i	93 15 26 49·785	+ 0 41 42·4	−0 16 55 32·158	+ 1 59 26·088
				ii	89 23 51 37	+ 2 52 31		ii	90 6 53 39·655	− 1 36 16·1	+1 15 4 5·027	− 0 25 26·744
				iii	88 12 40 25	− 1 10 51		iii	88 15 39 35·601	− 0 35 45·1	+0 14 30 32·082	+ 1 43 19·382
				iv	92 15 2 49	− 2 52 31		iv	92 15 48 45·359	+ 2 1 26·6	−2 1 17 4·917	− 0 48 27·330
xi	1261	2744	140	i	94 3 5 8	+ 0 51 7	xi	i	93 16 37 19·324	+ 0 45 33·5	−0 18 29 19·328	+ 1 33 47·170
				ii	90 2 11 17	+ 2 19 40		ii	90 8 39 10·495	− 1 35 18·7	+1 14 40 47·396	− 0 23 17·631
				iii	88 11 49 18	− 0 51 7		iii	88 14 59 54·160	− 0 39 7·7	+0 15 52 45·291	+ 1 22 13·209
				iv	92 12 43 9	− 2 19 40		iv	92 13 32 26·421	+ 1 59 41·8	−2 0 34 33·149	− 0 42 31·768
xii	1401	2604	140	i	94 4 2 9	+ 0 57 1	xii	i	93 17 59 11·562	+ 0 50 16·74	−0 20 24 16·051	+ 1 54 56·723
				ii	90 5 7 41	+ 2 56 24		ii	90 10 53 56·965	− 1 33 57·2	+1 14 7 42·911	− 0 33 4·485
				iii	88 10 52 17	− 0 57 1		iii	88 14 15 54·674	− 0 43 18·3	+0 17 34 27·276	+ 1 41 41·985
				iv	92 9 46 45	− 2 56 24		iv	92 10 39 47·199	+ 1 57 19·6	−1 23 36 50·650	− 0 57 42·499
xiii	1541	2464	112	i	94 4 51 33	+ 0 49 24	xiii	i	93 19 14 24·955	+ 0 54 52·9	−0 22 16 20·408	+ 1 52 4·357
				ii	90 8 5 51	+ 2 58 10		ii	90 13 11 21·735	− 1 32 26·4	+1 13 30 51·947	− 0 36 50·964
				iii	88 10 2 53	− 0 49 24		iii	88 13 38 0·461	− 0 47 26·1	+0 19 15 1·082	+ 1 40 33·806
				iv	92 6 48 35	− 2 58 10		iv	92 7 45 3·249	+ 1 54 45·2	−1 22 34 11·057	− 1 2 39·593
xiv	1653	2352	140	i	94 5 25 40	+ 0 34 7	xiv	i	93 20 8 35·644	+ 0 58 28·7	−0 23 43 55·031	+ 1 27 34·623
				ii	90 10 29 18	+ 2 23 27		ii	90 15 4 23·010	− 1 31 4·1	+1 12 57 28·013	− 0 33 23·934
				iii	88 9 28 46	− 0 34 7		iii	88 13 11 49·949	− 0 50 42·3	+0 20 34 38·423	+ 1 19 37·341
				iv	92 4 25 8	− 2 23 27		iv	92 5 24 1·797	+ 1 52 33·5	−1 21 40 44·228	− 0 53 26·829

TABLE II.

PART I.							PART II.					
						Difference.				Equation of the Centre.		Difference.
Period	A. M.	B. C.	Yrs.	Qr.	d. h. m. s.	h. m. s.	Period	Qr.	d. h. m. s.	° ′ ″	d. h. m. s.	h. m. s.
xv	1793	2212	112	i	94 6 1 23	+ 0 35 43	xv	i	93 21 10 24·072	+ 1 2 51·4	−1 1 30 31·644	+ 1 46 36·613
				ii	90 13 29 38	+ 3 0 20		ii	90 17 23 37·324	− 1 29 13·7	+1 12 12 39·828	− 0 44 48·185
				iii	88 8 53 3	− 0 35 43		iii	88 12 48 29·823	− 0 54 35·0	+0 22 9 4·552	+ 1 34 26·129
				iv	92 1 24 48	− 3 0 20		iv	92 2 26 19·181	+ 1 49 38·3	−1 20 29 38·225	− 1 11 6·003
xvi	1905	2100	140	i	94 6 24 17	+ 0 22 54	xvi	i	93 21 54 35·733	+ 1 6 16·2	−1 2 53 38·422	+ 1 23 6·778
				ii	90 15 54 29	+ 2 24 51		ii	90 19 17 12·779	− 1 27 37·8	+1 11 33 44·711	− 0 38 55·117
				iii	88 8 30 9	− 0 22 54		iii	88 12 33 43·470	− 0 57 39·0	+0 23 23 44·890	+ 1 14 40·338
				iv	91 22 59 57	− 2 24 51		iv	92 0 3 18·418	+ 1 47 10·7	−1 19 29 44·240	− 0 59 53·985
xvii	2045	1960	140	i	94 6 45 53	+ 0 21 36	xvii	i	93 22 43 22·543	+ 1 10 24·4	−1 4 34 21·968	+ 1 40 43·546
				ii	90 18 55 59	+ 3 1 30		ii	90 21 50 10·046	− 1 25 29·8	+1 10 41 47·975	− 0 51 56·736
				iii	88 8 8 33	− 0 21 36		iii	88 12 11 46·222	− 1 1 47·9	+1 1 4 45·421	+ 1 41 0·531
				iv	91 19 58 27	− 3 1 30		iv	91 21 3 31·589	+ 1 43 55·9	−1 18 10 40·957	− 1 19 3·283
xviii	2185	1820	112	i	94 7 0 0	+ 0 14 7	xviii	i	93 23 24 16·972	+ 1 14 23·8	−1 6 11 31·238	+ 1 37 9·270
				ii	90 21 57 38	+ 3 1 39		ii	91 0 19 18·487	− 1 23 11·2	+1 9 45 33·134	− 0 56 14·841
				iii	88 7 54 26	− 0 14 7		iii	88 12 1 59·430	− 1 5 36·8	+1 2 37 39·021	+ 1 32 53·600
				iv	91 16 56 48	− 3 1 39		iv	91 18 3 15·511	+ 1 40 31·1	−1 16 47 34·149	− 1 23 6·808
xix	2297	1708	140	i	94 7 5 45	+ 0 5 45	xix	i	93 23 51 47·838	+ 1 17 29·7	−1 7 26 40·735	+ 1 15 9·497
				ii	91 0 22 51	+ 2 25 13		ii	91 2 19 6·489	− 1 21 13·8	+1 8 57 54·503	− 0 47 38·631
				iii	88 7 48 41	− 0 5 45		iii	88 11 59 18·663	− 1 8 34·6	+1 3 49 48·392	+ 1 12 9·371
				iv	91 14 31 35	− 2 25 13		iv	91 15 38 37·410	+ 1 37 39·9	−1 15 38 5·545	− 1 9 28·604
xx	2437	1568	56	i	94 7 5 54	+ 0 0 9	xx	i	94 0 19 4·154	+ 1 21 11·9	−1 8 57 8·239	+ 1 30 27·504
				ii	91 3 24 1	+ 3 1 10		ii	91 4 51 27·263	− 1 18 38·1	+1 7 54 43·315	− 1 3 11·188
				iii	88 7 48 32	− 0 0 9		iii	88 12 0 26·841	− 1 12 14·3	+1 5 18 57·978	+ 1 29 9·586
				iv	91 11 30 25	− 3 1 10		iv	91 12 37 52·142	+ 1 33 57·4	−1 14 7 47·781	− 1 30 17·764
xxi	2493	1512	140	i	94 7 3 53	− 0 2 1	xxi	i	94 0 27 28·189	+ 1 22 37·6	−1 9 31 55·021	+ 0 34 46·782
				ii	91 4 36 18	+ 1 12 17		ii	91 5 52 31·862	− 1 17 33·1	+1 7 28 20·568	− 0 26 22·747
				iii	88 7 50 33	+ 0 2 1		iii	88 12 3 2·738	− 1 13 39·9	+1 5 53 39·830	+ 0 34 41·852
				iv	91 10 18 8	− 1 12 17		iv	91 11 25 47·611	+ 1 32 25·5	−1 13 30 30·032	− 0 37 17·749

TABLE II.

PART I.							PART II.					
						Difference.				Equation of the Centre.		Difference.
Period	A. M.	B. C.	Yrs.	Qr.	d. h. m. s.	h. m. s.	Period	Qr.	d. h. m. s.	° ′ ″	d. h. m. s.	h. m. s.
xxii	2633	1372	112	i	94 6 53 31	− 0 10 22	xx	i	94 0 44 26·028	+ 1 26 7·8	−1 10 57 13·286	+ 1 25 18·265
				ii	91 7 36 19	+ 3 0 1		ii	91 8 25 51·073	− 1 14 44·7	+1 6 20 0·142	− 1 8 20·426
				iii	88 8 0 55	+ 0 10 22		iii	88 12 13 21·155	− 1 17 9·2	+1 7 18 38·615	+ 1 24 58·785
				iv	91 7 18 7	− 3 0 1		iv	91 8 25 12·144	+ 1 28 30·7	−1 11 55 12·830	− 1 35 17·202
xxiii	2745	1260	140	i	94 6 39 41	− 0 13 50	xxiii	i	94 0 52 11·104	+ 1 28 47·8	−1 12 2 9·206	+ 1 4 55·920
				ii	91 9 59 33	+ 2 23 14		ii	91 10 28 58·711	− 1 12 23·8	+1 5 22 49·298	− 0 57 10·844
				iii	88 8 14 45	+ 0 13 50		iii	88 12 26 5·759	− 1 19 51·7	+1 8 24 35·409	+ 1 5 56·794
				iv	91 4 54 53	− 2 23 14		iv	91 6 1 34·826	+ 1 25 16·8	−1 10 36 31·432	− 1 18 41·398
xxiv	2885	1120	140	i	94 6 15 47	− 0 23 54	xxiv	i	94 0 54 42·010	+ 1 31 58·7	−1 13 19 37·495	+ 1 17 28·289
				ii	91 12 57 15	+ 2 57 42		ii	91 13 3 43·206	− 1 9 19·1	+1 4 7 51·915	− 1 14 57·383
				iii	88 8 38 39	+ 0 23 54		iii	88 12 47 43·587	− 1 23 8·3	+1 9 44 22·521	+ 1 19 47·112
				iv	91 1 57 11	− 2 57 42		iv	91 3 2 41·597	+ 1 21 6·9	−1 8 55 6·492	− 1 41 24·940
xxv	3025	980	112	i	94 5 44 32	− 0 31 15	xxv	i	94 0 49 44·947	+ 1 34 58·8	−1 14 32 42·810	+ 1 13 5·315
				ii	91 15 53 14	+ 2 55 59		ii	91 15 38 25·234	− 1 6 6·8	+1 2 49 49·537	− 1 18 2·378
				iii	88 9 9 54	+ 0 31 15		iii	88 13 15 31·469	− 1 26 17·2	+1 11 1 2·171	+ 1 16 39·650
				iv	90 23 1 12	− 2 55 59		iv	91 0 5 8·750	+ 1 16 49·5	−1 7 10 38·960	− 1 44 27·532
xxvi	3137	868	140	i	94 5 14 18	− 0 30 14	xxvi	i	94 0 40 2·994	+ 1 37 15·0	−1 15 27 59·242	+ 0 55 16·432
				ii	91 18 12 35	+ 2 19 21		ii	91 17 42 24·036	− 1 3 26·7	+1 1 44 51·152	− 1 4 58·385
				iii	88 9 40 8	+ 0 30 14		iii	88 13 42 6·391	− 1 28 42·6	+1 12 0 2·588	+ 0 59 0·417
				iv	90 20 41 51	− 2 19 21		iv	90 21 44 16·979	+ 1 13 18·6	−1 5 45 3·621	− 1 25 35·339
xxvii	3277	728	56	i	94 4 30 5	− 0 44 13	xxvii	i	94 0 21 10·802	+ 1 39 55·5	−1 16 33 7·337	+ 1 5 8·095
				ii	91 21 4 43	+ 2 52 8		ii	91 20 16 58·671	− 0 59 59·7	+1 0 20 50·865	− 1 24 0·287
				iii	88 10 24 21	+ 0 44 13		iii	88 14 21 1·509	− 1 31 36·5	+1 13 10 36·936	+ 1 10 34·348
				iv	90 17 49 43	− 2 52 8		iv	90 18 49 39·418	+ 1 8 48·8	−1 3 55 34·155	− 1 49 29·466
xxviii	3333	672	140	i	94 4 10 30	− 0 19 35	xxviii	i	94 0 12 23·918	+ 1 40 56·4	−1 16 57 50·191	+ 0 24 42·854
				ii	91 22 12 51	+ 1 8 8		ii	91 21 17 39·796	− 0 58 34·7	+0 23 47 21·127	− 0 33 29·738
				iii	88 10 43 56	+ 0 19 35		iii	88 14 38 13·957	− 1 32 43·5	+1 13 37 48·323	+ 0 27 11·387
				iv	90 16 41 35	− 1 8 8		iv	90 17 40 32·729	+ 1 6 59·4	−1 3 11 10·320	− 0 44 23·835

TABLE II.

PART I.							PART II.					
						Difference.				Equation of the Centre.		Difference.
Period	A. M.	B. C.	Yrs.	Qr.	d. h. m. s.	h. m. s.	Period	Qr.	d. h. m. s.	° ′ ″	d. h. m. s.	h. m. s.
xxix	3473	532	112	i	94 3 16 22	− 0 54 8	xxix	i	93 23 41 34·261	+ 1 43 20·6	−1 17 56 21·420	+ 0 58 31·229
				ii	92 1 1 16	+ 2 48 25		ii	91 23 52 35·591	− 0 54 57·0	+0 22 18 0·241	− 1 29 20·886
				iii	88 11 38 4	+ 0 54 8		iii	88 15 28 8·915	− 1 35 25·1	+1 14 43 23·232	+ 1 5 34·909
				iv	90 13 53 10	− 2 48 25		iv	90 14 46 31·633	+ 1 2 14·8	−1 1 15 40·453	− 1 55 29·867
xxx	3585	420	140	i	94 2 28 7	− 0 48 15	xxx	i	93 23 12 23·562	+ 1 45 7·8	−1 18 39 51·686	+ 0 43 30·266
				ii	92 3 13 54	+ 2 12 38		ii	92 1 55 9·110	− 0 51 57·9	+0 21 5 19·276	− 1 12 40·965
				iii	88 12 26 19	+ 0 48 15		iii	88 16 7 23·512	− 1 37 28·0	+1 15 33 15·786	+ 0 49 52·554
				iv	90 11 40 32	− 2 12 38		iv	90 12 33 54·216	+ 0 58 35·2	−0 23 46 33·302	− 1 29 7·151
xxxi	3725	280	140	i	94 1 21 53	− 1 6 14	xxxi	i	93 22 28 53·266	+ 1 47 10·9	−1 19 29 49·110	+ 0 49 57·424
				ii	92 5 56 39	+ 2 42 45		ii	92 4 26 50·983	− 0 48 7·6	+0 19 31 51·556	− 1 33 27·720
				iii	88 13 32 33	+ 1 6 14		iii	88 17 5 37·636	− 1 39 51·5	+1 16 31 29·939	+ 0 58 14·153
				iv	90 8 57 47	− 2 42 45		iv	90 9 47 28·515	+ 0 53 48·2	−0 21 50 5·025	− 1 56 28·277
xxxii	3865	140	112	i	94 0 8 52	− 1 13 1	xxxii	i	93 21 37 59·838	+ 1 49 2·1	−1 20 14 56·774	+ 0 45 7·664
				ii	92 8 36 11	+ 2 39 32		ii	92 6 57 58·707	− 0 44 11·0	+0 17 55 50·464	− 1 36 1·092
				iii	88 14 45 34	+ 1 13 1		iii	88 18 8 39·173	− 1 42 7·3	+1 17 26 36·571	+ 0 55 6·632
				iv	90 6 18 15	− 2 39 32		iv	90 7 4 12·682	+ 0 48 57·1	−0 19 51 56·856	− 1 58 8·169
xxxiii	3977	28	140	i	93 23 6 14	− 1 2 38	xxxiii	i	93 20 51 58·575	+ 1 50 22·6	−1 20 47 36·879	+ 0 32 40·105
				ii	92 10 41 2	+ 2 4 51		ii	92 8 57 24·795	− 0 40 57·1	+0 16 37 9·096	− 1 18 41·368
				iii	88 15 48 12	+ 1 2 38		iii	88 19 3 28·730	− 1 43 47·7	+1 18 7 21·291	+ 0 40 44·720
		A. D.		iv	90 4 13 24	− 2 4 51		iv	90 4 55 58·300	+ 0 45 1·6	−0 18 16 22·579	− 1 35 34·277
xxxiv	4117	113	112	i	93 21 42 10	− 1 24 4	xxxiv	i	93 19 47 51·383	+ 1 51 52·0	−1 21 23 53·753	+ 0 36 16·874
				ii	92 13 13 40	+ 2 32 38		ii	92 11 25 0·707	− 0 36 49·7	+0 14 56 45·030	− 1 40 24·066
				iii	88 17 12 16	+ 1 24 4		iii	88 20 16 58·455	− 1 45 44·0	+1 18 54 33·137	+ 0 47 11·846
				iv	90 1 40 46	− 2 32 38		iv	90 2 18 59·855	+ 0 40 4·2	−0 16 15 41·008	− 2 0 41·571
xxxv	4229	225	140	i	93 20 30 8	− 1 12 2	xxxv	i	93 18 51 27·046	+ 1 52 54·61	−1 21 49 18·245	+ 0 25 24·492
				ii	92 15 12 37	+ 1 58 57		ii	92 13 21 24·114	− 0 33 28·1	+0 13 34 56·201	− 1 21 48·829
				iii	88 18 24 18	+ 1 12 2		iii	88 21 19 45·322	− 1 47 9·2	+1 19 29 7·715	+ 0 34 34·578
				iv	89 23 41 49	− 1 58 57		iv	90 0 16 13·918	+ 0 36 4·3	−0 14 38 19·563	− 1 37 21·445

TABLE II.

PART I.							PART II.					
						Difference.				Equation of the Centre.		Difference.
Period	A. M.	A. D.	Yrs.	Qr.	d. h. m. s.	h. m. s.	Period	Qr.	d. h. m. s.	° ′ ″	d. h. m. s.	h. m. s.
xxxvi	4369	365	140	i	93 18 55 14	− 1 34 54	xxxvi	i	93 17 34 20·398	+ 1 54 1·7	−1 22 16 31·854	+ 0 27 13·609
				ii	92 17 37 37	+ 2 25 0		ii	92 15 45 6·242	− 0 29 11·0	+0 11 50 35·944	− 1 44 20·257
				iii	88 19 59 12	+ 1 34 54		iii	88 22 42 47·230	− 1 48 46·2	+1 20 8 29·586	+ 0 39 21·871
				iv	89 21 16 49	− 2 25 0		iv	89 21 46 36·530	+ 0 31 2·7	−0 12 35 55·784	− 2 2 23·779
xxxvii	4509	505	112	i	93 17 14 35	− 1 40 39	xxxvii	i	93 16 10 22·516	+ 1 54 56·4	−1 22 38 43·771	+ 0 22 11·917
				ii	92 19 58 56	+ 2 21 19		ii	92 18 6 2·794	− 0 24 49·4	+0 10 4 26·145	− 1 46 9·799
				iii	88 21 39 51	+ 1 40 39		iii	89 0 11 0·811	− 1 50 11·9	+1 20 43 16·339	+ 0 34 46·753
				iv	89 18 55 30	− 2 21 19		iv	89 19 21 24·279	+ 0 25 59·6	−0 10 32 55·450	− 2 3 0·334
xxxviii	4621	617	140	i	93 15 50 3	− 1 24 32	xxxviii	i	93 14 58 13·175	+ 1 55 31·0	−1 22 52 46·294	+ 0 14 2·523
				ii	92 21 46 27	+ 1 47 31		ii	92 19 56 47·833	− 0 21 17·0	+0 8 38 14·281	− 1 26 11·864
				iii	88 23 4 23	+ 1 24 32		iii	89 1 25 16·740	− 1 51 12·4	+1 21 7 49·514	+ 0 24 33·175
				iv	89 17 7 59	− 1 47 31		iv	89 17 28 32·652	+ 0 21 56·1	−0 8 54 6·346	− 1 38 49·104
xxxix	4761	757	112	i	93 13 59 45	− 1 50 18	xxxix	i	93 13 22 4·778	+ 1 56 3·1	−1 23 5 47·883	+ 0 13 1·589
				ii	92 23 57 56	+ 2 11 29		ii	92 22 12 25·376	− 0 16 48·0	+0 6 49 4·295	− 1 49 9·986
				iii	89 0 54 41	+ 1 50 18		iii	89 3 2 21·140	− 1 52 17·6	+1 21 34 17·071	+ 0 26 27·557
				iv	89 14 56 30	− 2 11 29		iv	89 15 11 59·106	+ 0 16 51·7	−0 6 50 34·389	− 2 3 31·957
xl	4873	869	140	i	93 12 27 53	− 1 31 52	xl	i	93 12 0 28·065	+ 1 56 19·8	−1 23 12 34·520	+ 0 6 46·637
				ii	93 1 39 27	+ 1 41 31		ii	92 23 58 35·264	− 0 13 10·2	+0 5 20 40·945	− 1 28 23·350
				iii	89 2 26 33	+ 1 31 52		iii	89 4 23 23·706	− 1 53 1·4	+1 21 52 3·609	+ 0 17 46·538
				iv	89 13 14 59	− 1 41 31		iv	89 13 26 23·365	+ 0 12 48·2	−0 5 11 45·285	− 1 38 49·104
xli	5013	1009	140	i	93 10 28 39	− 1 59 14	xli	i	93 10 12 48·172	+ 1 56 29·4	−1 23 16 28·275	+ 0 3 53·755
				ii	93 3 41 16	+ 2 1 49		ii	93 2 8 12·465	− 0 8 35·3	+0 3 29 7·297	− 1 51 33·648
				iii	89 4 25 47	+ 1 59 14		iii	89 6 8 44·866	− 1 53 45·9	+1 22 10 7·162	+ 0 18 3·553
				iv	89 11 13 10	− 2 1 49		iv	89 11 19 4·897	+ 0 7 44·1	−0 3 8 20·572	− 2 3 24·713
xlii	5153	1149	112	i	93 8 24 40	− 2 3 59	xlii	i	93 8 18 58·108	+ 1 56 26·5	−1 23 15 17·662	− 0 1 10·613
				ii	93 5 37 34	+ 1 56 18		ii	93 4 13 55·940	− 0 3 57·7	+0 1 36 27·846	− 1 52 39·451
				iii	89 6 29 46	+ 2 3 59		iii	89 7 58 26·535	− 1 54 18·1	+1 22 23 11·186	+ 0 13 4·024
				iv	89 9 16 52	− 1 56 18		iv	89 9 17 29·817	+ 0 2 41·6	−0 1 5 34·879	− 2 2 45·693

TABLE II.

PART I.

Period	A.M.	A.D.	Yrs.	Qr.	d. h. m. s.	Difference. h. m. s.
xliii	5265	1261	140	i	93 6 39 33	− 1 45 7
				ii	93 7 6 46	+ 1 29 12
				iii	89 8 14 53	+ 1 45 7
				iv	89 7 47 40	− 1 29 12
xliv	5405	1401	140	i	93 4 30 57	− 2 8 36
				ii	93 8 52 45	+ 1 45 59
				iii	89 10 23 29	+ 2 8 36
				iv	89 6 1 41	− 1 45 59
xlv	5545	1541	112	i	93 2 15 36	− 2 15 21
				ii	93 10 32 49	+ 1 40 4
				iii	89 12 38 50	+ 2 15 21
				iv	89 4 21 37	− 1 40 4
xlvi	5657	1653	140	i	93 0 24 34	− 1 51 2
				ii	93 11 48 25	+ 1 15 36
				iii	89 14 29 52	+ 1 51 2
				iv	89 3 6 1	− 1 15 36
xlvii	5797	1793	112	i	92 22 2 53	− 2 21 41
				ii	93 13 17 25	+ 1 29 0
				iii	89 16 51 33	+ 2 21 41
				iv	89 1 37 1	− 1 29 0
xlviii	5909	1905		i	92 20 7 15	− 1 55 38
				ii	93 14 23 57	+ 1 6 32
				iii	89 18 47 11	+ 1 55 38
				iv	89 0 30 29	− 1 6 32

PART II.

Period	Qr.	d. h. m. s.	Equation of the Centre. ° ′ ″	Equation of the Centre. d. h. m. s.	Difference. h. m. s.
xliii	i	93 6 32 14·949	+ 1 56 15·13	−1 23 10 40·807	− 0 4 36·855
	ii	93 6 3 1·055	+ 0 0 13·9	−0 0 5 38·458	− 1 30 49·388
	iii	89 9 28 51·574	− 1 54 35·3	+1 22 30 9·997	+ 0 6 58·811
	iv	89 7 44 42·822	− 0 1 18·4	+0 0 31 48·971	− 0 33 45·908
xliv	i	93 4 36 31·720	+ 1 55 49·88	−1 23 0 26·013	− 0 10 14·794
	ii	93 7 52 50·029	+ 0 4 33·8	−0 1 51 6·893	+ 1 45 28·435
	iii	89 11 23 35·208	− 1 54 46·0	+1 22 34 30·536	+ 0 4 20·539
	iv	89 5 55 53·443	− 0 6 11·8	+0 2 30 53·144	+ 1 59 4·173
xlv	i	93 2 25 51·698	+ 1 55 12·3	−1 22 45 10·959	− 0 15 15·054
	ii	93 9 47 40·908	+ 0 9 18·2	−0 3 46 31·861	+ 1 55 24·968
	iii	89 13 23 49·935	− 1 54 44·6	+1 22 33 56·447	− 0 0 34·089
	iv	89 4 11 27·859	− 0 11 6·7	+0 4 30 33·782	+ 1 59 40·638
xlvi	i	93 0 38 38·530	+ 1 54 33·4	−1 22 29 23·733	− 0 15 47·226
	ii	93 11 15 3·355	+ 0 13 3·5	−0 5 17 57·803	+ 1 31 25·942
	iii	89 15 3 54·521	− 1 54 34·6	+1 22 29 52·952	− 0 4 3·495
	iv	89 2 51 13·994	− 0 15 3·3	+0 6 6 34·873	+ 1 36 1·091
xlvii	i	92 22 21 38·689	+ 1 53 34·0	−1 22 5 37·402	− 0 23 46·331
	ii	93 12 58 49·522	+ 0 17 42·5	−0 7 11 11·313	+ 1 53 13·510
	iii	89 17 13 31·751	− 1 54 11·3	+1 22 20 25·609	− 0 9 27·343
	iv	89 1 14 50·438	− 0 19 59·4	+0 8 6 44·760	+ 2 0 9·887
xlviii	i	92 20 29 10·892	+ 1 52 37·9	−1 21 42 31·366	− 0 23 6·036
	ii	93 14 16 59·267	+ 0 21 22·7	−0 8 40 33·074	+ 1 29 21·761
	iii	89 19 0 49·728	− 1 53 43·7	+1 22 9 13·593	− 0 11 12·016
	iv	89 0 1 50·513	− 0 23 56·2	+0 9 42 50·721	+ 1 36 5·961

TABLE III.—Part I.

Mean annual Precession, or increment in the mean longitude of the fixed stars, from one to 7000 mean tropical years.

Years.	Deg.	Min.	Sec.
	°	′	″
1	..		50·069 541 029 207 232 267
2	..	1	40·139 082 058 414 464 534
3	..	2	30·208 623 087 621 696 801
4	..	3	20·278 164 116 828 929 068
5	..	4	10·347 705 146 036 161 335
6	..	5	0·417 246 175 243 393 602
7	..	5	50·486 787 204 450 625 869
8	..	6	40·556 328 233 657 858 136
9	..	7	30·625 869 262 865 090 403
10	..	8	20·695 410 292 072 322 67
20	..	16	41·390 820 584 144 645 34
30	..	25	2·086 230 876 216 968 01
40	..	33	22·781 641 168 289 290 68
50	..	41	43·477 051 460 361 613 35
60	..	50	4·172 461 752 433 936 02
70	..	58	24·867 872 044 506 258 69
80	1	6	45·563 282 336 578 581 36
90	1	15	6·258 692 628 650 904 03
100	1	23	26·954 102 920 723 226 7
200	2	46	53·908 205 841 446 453 4
300	4	10	20·862 308 762 169 680 1
400	5	33	47·816 411 682 892 906 8
500	6	57	14·770 514 603 616 133 5
600	8	20	41·724 617 524 339 360 2
700	9	44	8·678 720 445 062 586 9
800	11	7	35·632 823 365 785 813 6
900	12	31	2·586 926 286 509 040 3
1000	13	54	29·541 029 207 232 267
2000	27	48	59·082 058 414 464 534
3000	41	43	28·623 087 621 696 801
4000	55	37	58·164 116 828 929 068
5000	69	32	27·705 146 036 161 335
6000	83	26	57·246 175 243 393 602
7000	97	21	26·787 204 450 625 869

TABLE III.—Part II.

Mean noctidiurnal Precession, or increment in the mean longitude of the fixed stars, from one day to 365 days.

Days.	Sec.
	″
1	0·137 085 841
2	0·274 171 682
3	0·411 257 523
4	0·548 343 364
5	0·685 429 205
6	0·822 515 046
7	0·959 600 887
8	1·096 686 728
9	1·233 772 569
10	1·370 858 410
11	1·507 944 251
12	1·645 030 092
13	1·782 115 933
14	1·919 201 774
15	2·056 287 615
16	2·193 373 456
17	2·330 459 297
18	2·467 545 138
19	2·604 630 979
20	2·741 716 820
21	2·878 802 661
22	3·015 888 502
23	3·152 974 343
24	3·290 060 184
25	3·427 146 025
26	3·564 231 866
27	3·701 317 707
28	3·838 403 548
29	3·975 489 389
30	4·112 575 230
31	4·249 661 071

Months.	Days.	Sec.
		″
1	30	4·112 575 23
2	60	8·225 150 46
3	90	12·337 725 69
4	120	16·450 300 92
5	150	20·562 876 15
6	180	24·675 451 38
7	210	28·788 026 61
8	240	32·900 601 84
9	270	37·013 177 07
10	300	41·125 752 30
11	330	45·238 327 53
12	360	49·350 902 76
	5	0·685 429 205
	365	50·036 331 965

One hour $=0''\cdot005\ 711\ 91$

TABLE IV.—Part I.

Mean annual increment in Right Ascension in hours minutes and seconds, from one to 7000 mean tropical years.

Years.	Hrs.	Min.	Sec.
1	..	..	3·337 969 401 947 148 817 8
2	..	..	6·675 938 803 894 297 635 6
3	..	..	10·013 908 205 841 446 453 4
4	..	..	13·351 877 607 788 595 271 2
5	..	..	16·689 847 009 735 744 089 0
6	..	..	20·027 816 411 682 892 906 8
7	..	..	23·365 785 813 630 041 724 6
8	..	..	26·703 755 215 577 190 542 4
9	..	..	30·041 724 617 524 339 360 2
10	..	..	33·379 694 019 471 488 178 0
20	..	1	6·759 388 038 942 976 356
30	..	1	40·139 082 058 414 464 534
40	..	2	13·518 776 077 885 952 712
50	..	2	46·898 470 097 357 440 890
60	..	3	20·278 164 116 828 929 068
70	..	3	53·657 858 136 300 417 246
80	..	4	27·037 552 155 771 905 424
90	..	5	0·417 246 175 243 393 602
100	..	5	33·796 940 194 714 881 78
200	..	11	7·593 880 389 429 763 56
300	..	16	41·390 820 584 144 645 34
400	..	22	15·187 760 778 859 527 12
500	..	27	48·984 700 973 574 408 90
600	..	33	22·781 641 168 289 290 68
700	..	38	56·578 581 363 004 172 46
800	..	44	30·375 521 557 719 054 24
900	..	50	4·172 461 752 433 936 02
1000	..	55	37·969 401 947 148 817 80
2000	1	51	15·938 803 894 297 635 6
3000	2	46	53·908 205 841 446 453 4
4000	3	42	31·877 607 788 595 271 2
5000	4	38	9·847 009 735 744 089
6000	5	33	47·816 411 682 892 906 8
7000	6	29	25·785 813 630 041 724 6

TABLE IV.—Part II.

Mean noctidiurnal increment in Right Ascension, from one day to 365 days.

Days.	Sec.	Days.	Sec.
1	0·009 139 056	30	0·274 171 68
2	0·018 278 112	60	0·548 343 36
3	0·027 417 168	90	0·822 515 04
4	0·036 556 224	120	1·096 686 72
5	0·045 695 280	150	1·370 858 40
6	0·054 834 336	180	1·645 030 08
7	0·063 973 392	210	1·919 201 76
8	0·073 112 448	240	2·193 373 44
9	0·082 251 504	270	2·467 545 12
10	0·091 390 560	300	2·741 716 80
11	0·100 529 616	330	3·015 888 48
12	0·109 668 672	360	3·290 060 16
13	0·118 807 728	5	0·045 695 28
14	0·127 946 784	365	3·335 755 44
15	0·137 085 840	1 hour = 0·000 380 794	
16	0·146 224 896		
17	0·155 363 952		
18	0·164 503 008		
19	0·173 642 064		
20	0·182 781 120		
21	0·191 920 176		
22	0·201 059 232		
23	0·210 198 288		
24	0·219 337 344		
25	0·228 476 400		
26	0·237 615 456		
27	0·246 754 512		
28	0·255 893 568		
29	0·265 032 624		
30	0·274 171 680		
31	0·283 310 736		

TABLE V.—Part I.

Mean annual motion of the Solar Apogee, reckoned from the mean vernal equinox, A. M. 1 B. C. 4004, *to the mean vernal equinox perpetually, from one to 7000 mean tropical years.*

Years.	Deg.	Min.	Sec.
	°	′	″
1	..	1	1·729 541
2	..	2	3·459 082
3	..	3	5·188 623
4	..	4	6·918 164
5	..	5	8·647 705
6	..	6	10·377 246
7	..	7	12·106 787
8	..	8	13·836 328
9	..	9	15·565 869
10	..	10	17·295 410
20	..	20	34·590 82
30	..	30	51·886 23
40	..	41	9·181 64
50	..	51	26·477 05
60	1	1	43·772 46
70	1	12	1·067 87
80	1	22	18·363 28
90	1	32	35·658 69
100	1	42	52·954 1
200	3	25	45·908 2
300	5	8	38·862 3
400	6	51	31·816 4
500	8	34	24·770 5
600	10	17	17·724 6
700	12	0	10·678 7
800	13	43	3·632 8
900	15	25	56·586 9
1000	17	8	49·541
2000	34	17	39·082
3000	51	26	28·623
4000	68	35	18·164
5000	85	44	7·705
6000	102	52	57·246
7000	120	1	46·787

TABLE V.—Part II.

Mean noctidiurnal motion of the Solar Apogee, from one day to 365 days.

Days.	Sec.
1	″ 0·169 009 858 5
2	0·338 019 717 0
3	0·507 029 575 5
4	0·676 039 434 0
5	0·845 049 292 5
6	1·014 059 151 0
7	1·183 069 009 5
8	1·352 078 868 0
9	1·521 088 726 5
10	1·690 098 585 0
11	1·859 108 443 5
12	2·028 118 302 0
13	2·197 128 160 5
14	2·366 138 019 0
15	2·535 147 877 5
16	2·704 157 736 0
17	2·873 167 594 5
18	3·042 177 453 0
19	3·211 187 311 5
20	3·380 197 170 0
21	3·549 207 028 5
22	3·718 216 887 0
23	3·887 226 745 5
24	4·056 236 604 0
25	4·225 246 462 5
26	4·394 256 321 0
27	4·563 266 179 5
28	4·732 276 038 0
29	4·901 285 896 5
30	5·070 295 755 0
31	5·239 305 613 5

Months.	Days.	Min.	Sec.
1	30	′ ..	″ 5·070 295 755
2	60	..	10·140 591 510
3	90	..	15·210 887 265
4	120	..	20·281 183 020
5	150	..	25·351 478 775
6	180	..	30·421 774 530
7	210	..	35·492 070 285
8	240	..	40·562 366 040
9	270	..	45·632 661 795
10	300	..	50·702 957 550
11	330	..	55·773 253 305
12	360	1	0·843 549 060
	5	..	0·845 049 292 5
	365	1	1·688 598 352 5

One hour = 0′ 0″·007 042 077 437 5

TABLE VI.

Epochs of the Solar Apogee, reckoned from the mean vernal equinox perpetually, at the beginning of each of the Julian Periods of the Fasti *.

Julian Periods.	Epochs of the Apogee.		
	°	′	″
i	0	0	0·000 000
ii	1	55	13·708 592
iii	4	19	15·844 332
iv	6	14	29·552 924
v	8	38	31·688 664
vi	10	33	45·397 256
vii	12	57	47·532 996
viii	15	21	49·668 736
ix	17	17	3·377 328
x	19	41	5·513 068
xi	21	36	19·221 660
xii	24	0	21·357 400
xiii	26	24	23·493 140
xiv	28	19	37·201 732
xv	30	43	39·337 472
xvi	32	38	53·046 064
xvii	35	2	55·181 804
xviii	37	26	57·317 544
xix	39	22	11·026 136
xx	41	46	13·161 876
xxi	42	43	50·016 172
xxii	45	7	52·151 912
xxiii	47	3	5·860 504
xxiv	49	27	7·996 244
xxv	51	51	10·131 984
xxvi	53	46	23·840 576
xxvii	56	10	25·976 316
xxviii	57	8	2·830 612
xxix	59	32	4·966 352
xxx	61	27	18·674 944
xxxi	63	51	20·810 684
xxxii	66	15	22·946 424
xxxiii	68	10	36·655 016
xxxiv	70	34	38·790 756
xxxv	72	29	52·499 348
xxxvi	74	53	54·635 088
xxxvii	77	17	56·770 828
xxxviii	79	13	10·479 420
xxxix	81	37	12·615 160
xl	83	32	26·323 752
xli	85	56	28·459 492
xlii	88	20	30·595 232
xliii	90	15	44·303 824
xliv	92	39	46·439 564
xlv	95	3	48·575 304
xlvi	96	59	2·283 896
xlvii	99	23	4·419 636
xlviii	101	18	18·128 228

* In the period of 56 years the epoch advances 0° 57′ 36″·854 296
In the period of 112 years the epoch advances 1 55 13·708 592
In the period of 140 years the epoch advances 2 24 2·135 74

TABLE VII.—Part I.

Mean motion of the Sun in longitude in mean solar days, from one day to 365 days.

Days.	°	′	″
1		59	8·329 909 806 436 56
2	1	58	16·659 819 612 873 12
3	2	57	24·989 729 419 309 68
4	3	56	33·319 639 225 746 24
5	4	55	41·649 549 032 182 80
6	5	54	49·979 458 838 619 36
7	6	53	58·309 368 645 055 92
8	7	53	6·639 278 451 492 48
9	8	52	14·969 188 257 929 04
10	9	51	23·299 098 064 365 60
11	10	50	31·629 007 870 802 16
12	11	49	39·958 917 677 238 72
13	12	48	48·288 827 483 675 28
14	13	47	56·618 737 290 111 84
15	14	47	4·948 647 096 548 40
16	15	46	13·278 556 902 984 96
17	16	45	21·608 466 709 421 52
18	17	44	29·938 376 515 858 08
19	18	43	38·268 286 322 294 64
20	19	42	46·598 196 128 731 20
21	20	41	54·928 105 935 167 76
22	21	41	3·258 015 741 604 32
23	22	40	11·587 925 548 040 88
24	23	39	19·917 835 354 477 44
25	24	38	28·247 745 160 914
26	25	37	36·577 654 967 350 56
27	26	36	44·907 564 773 787 12
28	27	35	53·237 474 580 223 68
29	28	35	1·567 384 386 660 24
30	29	34	9·897 294 193 096 8
31	30	33	18·227 203 999 533 36

Months.	Days.	°	′	″
1	30	29	34	9·897 294 193 096 8
2	60	59	8	19·794 588 386 193 6
3	90	88	42	29·691 882 579 290 4
4	120	118	16	39·589 176 772 387 2
5	150	147	50	49·486 470 965 484
6	180	177	24	59·383 765 158 580 8
7	210	206	59	9·281 059 351 677 6
8	240	236	33	19·178 353 544 774 4
9	270	266	7	29·075 647 737 871 2
10	300	295	41	38·972 941 930 968
11	330	325	15	48·870 236 124 064 8
12	360	354	49	58·767 530 317 161 6
	5	4	55	41·649 549 032 182 8
	365	359	45	40·417 079 349 344 4
	6h		14	47·082 477 451 609 14
	365d 6h	360	0	27·499 556 800 953 54

TABLE VII.—Part II.

Mean motion of the Sun in longitude in mean solar hours, from one hour to 24.

Hours.	″
1	2·464 117 992 921 136 5
2	4·928 235 985 842 273
3	7·392 353 978 763 409 5
4	9·856 471 971 684 546
5	12·320 589 964 605 682 5
6	14·784 707 957 526 819
7	17·248 825 950 447 955 5
8	19·712 943 943 369 092
9	22·177 061 936 290 228 5
10	24·641 179 929 211 365
11	27·105 297 922 132 501 5
12	29·569 415 915 053 638
13	32·033 533 907 974 774 5
14	34·497 651 900 895 911
15	36·961 769 893 817 047 5
16	39·425 887 886 738 184
17	41·890 005 879 659 320 5
18	44·354 123 872 580 457
19	46·818 241 865 501 593 5
20	49·282 359 858 422 73
21	51·746 477 851 343 866 5
22	54·210 595 844 265 003
23	56·674 713 837 186 139 5
24	59·138 831 830 107 276
	=59′ 8″· 329 909 806 436 56

TABLE VII.—Part III.

Mean motion of the Sun in longitude in mean solar minutes, from one minute to 60.

Minutes.		Minutes.	
1	′0·041 068 633 215 352 275	31	′1·273 127 629 675 920 525
2	0·082 137 266 430 704 55	32	1·314 196 262 891 272 8
3	0·123 205 899 646 056 825	33	1·355 264 896 106 625 075
4	0·164 274 532 861 409 1	34	1·396 333 529 321 977 35
5	0·205 343 166 076 761 375	35	1·437 402 162 537 329 625
6	0·246 411 799 292 113 65	36	1·478 470 795 752 681 9
7	0·287 480 432 507 465 925	37	1·519 539 428 968 034 175
8	0·328 549 065 722 818 2	38	1·560 608 062 183 386 45
9	0·369 617 698 938 170 475	39	1·601 676 695 398 738 725
10	0·410 686 332 153 522 75	40	1·642 745 328 614 091
11	0·451 754 965 368 875 025	41	1·683 813 961 829 443 275
12	0·492 823 598 584 227 3	42	1·724 882 595 044 795 55
13	0·533 892 231 799 579 575	43	1·765 951 228 260 147 825
14	0·574 960 865 014 931 85	44	1·807 019 861 475 500 1
15	0·616 029 498 230 284 125	45	1·848 088 494 690 852 375
16	0·657 098 131 445 636 49	46	1·889 157 127 906 204 65
17	0·698 166 764 660 988 675	47	1·930 225 761 121 556 925
18	0·739 235 397 876 340 95	48	1·971 294 394 336 909 2
19	0·780 304 031 091 693 225	49	2·012 363 027 552 261 475
20	0·821 372 664 307 045 5	50	2·053 431 660 767 613 75
21	0·862 441 297 522 397 775	51	2·094 500 293 982 966 025
22	0·903 509 930 737 750 05	52	2·135 568 927 198 318 3
23	0·944 578 563 953 102 325	53	2·176 637 560 413 670 575
24	0·985 647 197 168 454 6	54	2·217 706 193 629 022 85
25	1·026 715 830 383 806 875	55	2·258 774 826 844 375 125
26	1·067 784 463 599 159 15	56	2·299 843 460 059 727 4
27	1·108 853 096 814 511 425	57	2·340 912 093 275 079 675
28	1·149 921 730 029 863 7	58	2·381 980 726 490 431 95
29	1·190 990 363 245 215 975	59	2·423 049 359 705 784 225
30	1·232 058 996 460 568 25	60	2·464 117 992 921 136 5

TABLE VII.—Part IV.

Mean motion of the Sun in longitude in mean solar seconds, from one second to 60; and in decimal parts of mean solar seconds, from one to 10.

Sec.		Sec.	
1	′0·000 684 477 220 255 871 25	31	′0·021 218 793 827 932 008 75
2	0·001 368 954 440 511 742 5	32	0·021 903 271 048 187 88
3	0·002 053 431 660 767 613 75	33	0·022 587 748 268 443 751 25
4	0·002 737 908 881 023 485	34	0·023 272 225 488 699 622 5
5	0·003 422 386 101 279 356 25	35	0·023 956 702 708 955 493 75
6	0·004 106 863 321 535 227 5	36	0·024 641 179 929 211 365
7	0·004 791 340 541 791 098 75	37	0·025 325 657 149 467 236 25
8	0·005 475 817 762 046 97	38	0·026 010 134 369 723 107 5
9	0·006 160 294 982 302 841 25	39	0·026 694 611 589 978 978 75
10	0·006 844 772 202 558 712 5	40	0·027 379 088 810 234 85
11	0·007 529 249 422 814 583 75	41	0·028 063 566 030 490 721 25
12	0·008 213 726 643 070 455.	42	0·028 748 043 250 746 592 5
13	0·008 898 203 863 326 326 25	43	0·029 432 520 471 002 463 75
14	0·009 582 681 083 582 197 5	44	0·030 116 997 691 258 335
15	0·010 267 158 303 838 068 75	45	0·030 801 474 911 514 206 25
16	0·010 951 635 524 093 94	46	0·031 485 952 131 770 077 5
17	0·011 636 112 744 349 811 25	47	0·032 170 429 352 025 948 75
18	0·012 320 589 964 605 682 5	48	0·032 854 906 572 281 82
19	0·013 005 067 184 861 553 75	49	0·033 539 383 792 537 691 25
20	0·013 689 544 405 117 425	50	0·034 223 861 012 793 562 5
21	0·014 374 021 625 373 296 25	51	0·034 908 338 233 049 433 75
22	0·015 058 498 845 629 167 5	52	0·035 592 815 453 305 305
23	0·015 742 976 065 885 038 75	53	0·036 277 292 673 561 176 25
24	0·016 427 453 286 140 91	54	0·036 961 769 893 817 047 5
25	0·017 111 930 506 396 781 25	55	0·037 646 247 114 072 918 75
26	0·017 796 407 726 652 652 5	56	0·038 330 724 334 328 79
27	0·018 480 884 946 908 523 75	57	0·039 015 201 554 584 661 25
28	0·019 165 362 167 164 395	58	0·039 699 678 774 840 532 5
29	0·019 849 839 387 420 266 25	59	0·040 384 155 995 096 403 75
30	0·020 534 316 607 676 137 5	60	0·041 068 633 215 352 275

Decimal parts of seconds.

Sec.		Sec.	
0·1	′0·000 068 447 722 025 587 125	0·6	′0·000 410 686 332 153 522 75
0·2	0·000 136 895 444 051 174 25	0·7	0·000 479 134 054 179 109 875
0·3	0·000 205 343 166 076 761 375	0·8	0·000 547 581 776 204 697
0·4	0·000 273 790 888 102 348 5	0·9	0·000 616 029 498 230 284 125
0·5	0·000 342 238 610 127 935 625	1·0	0·000 684 477 220 255 871 25

TABLE VIII.—Part I.

Mean motion of the Sun in degrees and signs, reduced to mean solar time.

Deg.	d.	h.	m.	Deg.	Signs.	d.	h.	m.
1	1	0	20·969	30	1	30	10	29·070
2	2	0	41·938	60	2	60	20	58·140
3	3	1	2·907	90	3	91	7	27·210
4	4	1	23·876	120	4	121	17	56·280
5	5	1	44·845	150	5	152	4	25·35
6	6	2	5·814	180	6	182	14	54·42
7	7	2	26·783	210	7	213	1	23·49
8	8	2	47·752	240	8	243	11	52·56
9	9	3	8·721	270	9	273	22	21·63
10	10	3	29·690	300	10	304	8	50·7
11	11	3	50·659	330	11	334	19	19·77
12	12	4	11·628	360	12	365	5	48·84
13	13	4	32·597	=365d. 5h. 48m. 50s. 24th.				
14	14	4	53·566					
15	15	5	14·535					
16	16	5	35·504					
17	17	5	56·473					
18	18	6	17·442					
19	19	6	38·411					
20	20	6	59·380					
21	21	7	20·349					
22	22	7	41·318					
23	23	8	2·287					
24	24	8	23·256					
25	25	8	44·225					
26	26	9	5·194					
27	27	9	26·163					
28	28	9	47·132					
29	29	10	8·101					
30	30	10	29·070					
31	31	11	50·039					

TABLE VIII.—Part II.

Mean motion of the Sun in minutes, seconds, and decimal parts of seconds, of a degree, reduced to mean solar time.

″	Min.	Sec.	″	Min.	Sec.
′	Hrs.	Min.	′	Hrs.	Min.
1	..	24·349 483 333 32	31	12	34·833 983 332 92
2	..	48·698 966 666 64	32	12	59·183 466 666 24
3	1	13·048 449 999 96	33	13	23·532 949 999 56
4	1	37·397 933 333 28	34	13	47·882 433 332 88
5	2	1·747 416 666 6	35	14	12·231 916 666 2
6	2	26·096 899 999 92	36	14	36·581 399 999 52
7	2	50·446 383 333 24	37	15	0·930 883 332 84
8	3	14·795 866 666 56	38	15	25·280 366 666 16
9	3	39·145 349 999 88	39	15	49·629 849 999 48
10	4	3·494 833 333 2	40	16	13·979 333 332 8
11	4	27·844 316 666 52	41	16	38·328 816 666 12
12	4	52·193 799 999 84	42	17	2·678 299 999 44
13	5	16·543 283 333 16	43	17	27·027 783 332 76
14	5	40·892 766 666 48	44	17	51·377 266 666 08
15	6	5·242 249 999 8	45	18	15·726 749 999 4
16	6	29·591 733 333 12	46	18	40·076 233 332 72
17	6	53·941 216 666 44	47	19	4·425 716 666 04
18	7	18·290 699 999 76	48	19	28·775 199 999 36
19	7	42·640 183 333 08	49	19	53·124 683 332 68
20	8	6·989 666 666 4	50	20	17·474 166 666
21	8	31·339 149 999 72	51	20	41·823 649 999 32
22	8	55·688 633 333 04	52	21	6·173 133 332 64
23	9	20·038 116 666 36	53	21	30·522 616 665 96
24	9	44·387 599 999 68	54	21	54·872 099 999 28
25	10	8·737 083 333	55	22	19·221 583 332 6
26	10	33·086 566 666 32	56	22	43·571 066 665 92
27	10	57·436 049 999 64	57	23	7·920 549 999 24
28	11	21·785 533 332 96	58	23	32·270 033 332 56
29	11	46·135 016 666 28	59	23	56·619 516 665 88
30	12	10·484 499 999 6	60	24	20·968 999 999 2

Decimal parts of a second.

″	Sec.
0·1	2·434 948 333 332
0·2	4·869 896 666 664
0·3	7·304 844 999 996
0·4	9·739 793 333 328
0·5	12·174 741 666 66
0·6	14·609 689 999 992
0·7	17·044 638 333 324
0·8	19·479 586 666 656
0·9	21·914 534 999 988
1·0	24·349 483 333 32

TABLE IX.

Mean motion of the Sun in longitude in the Equable year, Cyclical or Nabonassarian, from one to 7000 equable years.

EPOCHS.

Æra Cyc.	A.M.	B.C.	Nab.	At Jerusalem.	At Greenwich.
				Mean midnight. ° ′ ″	Mean midnight. ° ′ ″
0—1	1	4004	Mesore 10 = April 25	0 0 0·000 000	April 25 0 5 46·906 745
				Mean noon. ° ′ ″	Mean noon. ° ′ ″
0—1	1	4004½	Mesore 10 = April 25	0 29 34·164 955	April 25 0 35 21·071 700

Æra Cyc.	Nab.	A.M.	A.D.	Nab.	At Jerusalem.	At Greenwich.
					Mean midnight. ° ′ ″	Mean midnight. ° ′ ″
5808–5809	2549–2550	5805	1801	Mesore 10 = May 4	53 12 22·396 861	May 4 53 18 9·303 606
					Mean noon. ° ′ ″	Mean noon. ° ′ ″
5808–5809	2549–2550	5805	1801	Mesore 10 = May 4	53 41 56·561 816	May 4 53 47 43·468 561

Equable Years.	Revolutions.	°	′	″
1		359	45	40·417 079 349 344 4
2	1	359	31	20·834 158 698 688 8
3	2	359	17	1·251 238 048 033 2
4	3	359	2	41·668 317 397 377 6
5	4	358	48	22·085 396 746 722
6	5	358	34	2·502 476 096 066 4
7	6	358	19	42·919 555 445 410 8
8	7	358	5	23·336 634 794 755 2
9	8	357	51	3·753 714 144 099 6
10	9	357	36	44·170 793 493 444
20	19	355	13	28·341 586 986 888
30	29	352	50	12·512 380 480 332
40	39	350	26	56·683 173 973 776
50	49	348	3	40·853 967 467 22
60	59	345	40	25·024 760 960 664
70	69	343	17	9·195 554 454 108
80	79	340	53	53·366 347 947 552
90	89	338	30	37·537 141 440 996
100	99	336	7	21·707 934 934 44
200	199	312	14	43·415 869 868 88
300	299	288	22	5·123 804 803 32
400	399	264	29	26·831 739 737 76
500	499	240	36	48·539 674 672 2
600	599	216	44	10·247 609 606 64
700	699	192	51	31·955 544 541 08
800	799	168	58	53·663 479 475 52
900	899	145	6	15·371 414 409 96
1000	999	121	13	37·079 349 344 4
2000	1,998	242	27	14·158 698 688 8
3000	2,998	3	40	51·238 048 033 2
4000	3,997	124	54	28·317 397 377 6
5000	4,996	246	8	5·396 746 722
6000	5,996	7	21	42·476 096 066 4
7000	6,995	128	35	19·555 445 410 8

TABLE X.

Mean motion of the Sun in longitude in the mean Julian year, from one to 7000 mean Julian years.

EPOCHS.

Cycle of leap-yr.	A. M.	B. C.	At Jerusalem. Mean midnight.	°	′	″	At Greenwich. Mean midnight.	°	′	″
2	1	4004	April 25	0	0	0·000 000	April 25	0	5	46·906 745
3	2	4003	April 25	359	45	40·417 079	April 25	359	51	27·323 824
4	3	4002	April 25	359	31	20·834 159	April 25	359	37	7·740 903
1	4	4001	April 25	0	16	9·581 148	April 25	0	21	56·487 893
			Mean noon.	°	′	″	Mean noon.	°	′	″
2	1	4004	April 25	0	29	34·164 955	April 25	0	35	21·071 700
3	2	4003	April 25	0	15	14·582 034	April 25	0	21	1·488 779
4	3	4002	April 25	0	0	54·999 114	April 25	0	6	41·905 858
1	4	4001	April 25	0	45	43·746 103	April 25	0	51	30·652 848

Cycle of leap-yr.	A. M.	A. D.	At Jerusalem. Mean midnight.	°	′	″	At Greenwich. Mean midnight.	°	′	″
2	5805	1801	April 24	43	20	59·097 763	April 24	43	26	46·004 508
3	5806	1802	April 24	43	6	39·514 842	April 24	43	12	26·421 587
4	5807	1803	April 24	42	52	19·931 922	April 24	42	58	6·838 666
1	5808	1804	April 24	43	37	8·678 911	April 24	43	42	55·585 656
			Mean noon.	°	′	″	Mean noon.	°	′	″
2	5805	1801	April 24	43	50	33·262 718	April 24	43	56	20·169 463
3	5806	1802	April 24	43	36	13·679 797	April 24	43	42	0·586 542
4	5807	1803	April 24	43	21	54·096 877	April 24	43	27	41·003 621
1	5808	1804	April 24	44	6	42·843 866	April 24	44	12	29·750 610

Julian Years.	Revolutions.	°	′	″
1	1	0	0	27·499 556 800 953 54
2	2	0	0	54·999 113 601 907 08
3	3	0	1	22·498 670 402 860 62
4	4	0	1	49·998 227 203 814 16
5	5	0	2	17·497 784 004 767 7
6	6	0	2	44·997 340 805 721 24
7	7	0	3	12·496 897 606 674 78
8	8	0	3	39·996 454 407 628 32
9	9	0	4	7·496 011 208 581 86
10	10	0	4	34·995 568 009 535 4
20	20	0	9	9·991 136 019 070 8
30	30	0	13	44·986 704 028 606 2
40	40	0	18	19·982 272 038 141 6
50	50	0	22	54·977 840 047 677
60	60	0	27	29·973 408 057 212 4
70	70	0	32	4·968 976 066 747 8
80	80	0	36	39·964 544 076 283 2
90	90	0	41	14·960 112 085 818 6
100	100	0	45	49·955 680 095 354
200	200	1	31	39·911 360 190 708
300	300	2	17	29·867 040 286 062
400	400	3	3	19·822 720 381 416
500	500	3	49	9·778 400 476 77
600	600	4	34	59·734 080 572 124
700	700	5	20	49·689 760 667 478
800	800	6	6	39·645 440 762 832
900	900	6	52	29·601 120 858 186
1000	1000	7	38	19·556 800 953 54
2000	2000	15	16	39·113 601 907 08
3000	3000	22	54	58·670 402 860 62
4000	4000	30	33	18·227 203 814 16
5000	5000	38	11	37·784 004 767 7
6000	6000	45	49	57·340 805 721 24
7000	7000	53	28	16·897 606 674 78

TABLE XI.—Part I.

Mean motion of the Moon in longitude in mean solar days, from one day to 365 days.

Days.	Revs.	°	′	″
1		13	10	35·027 004
2		26	21	10·054 008
3		39	31	45·081 012
4		52	42	20·108 016
5		65	52	55·135 020
6		79	3	30·162 024
7		92	14	5·189 028
8		105	24	40·216 032
9		118	35	15·243 036
10		131	45	50·270 040
11		144	56	25·297 044
12		158	7	0·324 048
13		171	17	35·351 052
14		184	28	10·378 056
15		197	38	45·405 060
16		210	49	20·432 064
17		223	59	55·459 068
18		237	10	30·486 072
19		250	21	5·513 076
20		263	31	40·540 080
21		276	42	15·567 084
22		289	52	50·594 088
23		303	3	25·621 092
24		316	14	0·648 096
25		329	24	35·675 100
26		342	35	10·702 104
27		355	45	45·729 108
28	1	8	56	20·756 112
29	1	22	6	55·783 116
30	1	35	17	30·810 120
31	1	48	28	5·837 124

Months.	Days.	Revs.	°	′	″
1	30	1	35	17	30·810 12
2	60	2	70	35	1·620 24
3	90	3	105	52	32·430 36
4	120	4	141	10	3·240 48
5	150	5	176	27	34·050 60
6	180	6	211	45	4·860 72
7	210	7	247	2	35·670 84
8	240	8	282	20	6·480 96
9	270	9	317	37	37·291 08
10	300	10	352	55	8·101 20
11	330	12	28	12	38·911 32
12	360	13	63	30	9·721 44
	5		65	52	55·135 02
	365	13	129	23	4·856 46
	6h		3	17	38·756 751
	365d 6h	13	132	40	43·613 211

TABLE XI.—Part II.

Mean motion of the Moon in longitude in mean solar hours, from one hour to 24.

Hours.	°	′
1		32·940 990 975
2	1	5·881 981 95
3	1	38·822 972 925
4	2	11·763 963 9
5	2	44·704 954 875
6	3	17·645 945 85
7	3	50·586 936 825
8	4	23·527 927 8
9	4	56·468 918 775
10	5	29·409 909 75
11	6	2·350 900 725
12	6	35·291 891 7
13	7	8·232 882 675
14	7	41·173 873 65
15	8	14·114 864 625
16	8	47·055 855 6
17	9	19·996 846 575
18	9	52·937 837 55
19	10	25·878 828 525
20	10	58·819 819 5
21	11	31·760 810 475
22	12	4·701 801 45
23	12	37·642 792 425
24	13	10·583 783 4
	=13° 10′ 35″·027 004	

TABLE XI.—PART III.

Mean motion of the Moon in longitude in mean solar minutes, from one minute to 60.

Min.	′	Min.	′
1	0·549 016 516 25	31	17·019 512 003 75
2	1·098 033 032 5	32	17·568 528 52
3	1·647 049 548 75	33	18·117 545 036 25
4	2·196 066 065	34	18·666 561 552 5
5	2·745 082 581 25	35	19·215 578 068 75
6	3·294 099 097 5	36	19·764 594 585
7	3·843 115 613 75	37	20·313 611 101 25
8	4·392 132 13	38	20·862 627 617 5
9	4·941 148 646 25	39	21·411 644 133 75
10	5·490 165 162 5	40	21·960 660 65
11	6·039 181 678 75	41	22·509 677 166 25
12	6·588 198 195	42	23·058 693 682 5
13	7·137 214 711 25	43	23·607 710 198 75
14	7·686 231 227 5	44	24·156 726 715
15	8·235 247 743 75	45	24·705 743 231 25
16	8·784 264 26	46	25·254 759 747 5
17	9·333 280 776 25	47	25·803 776 263 75
18	9·882 297 292 5	48	26·352 792 78
19	10·431 313 808 75	49	26·901 809 296 25
20	10·980 330 325	50	27·450 825 812 5
21	11·529 346 841 25	51	27·999 842 328 75
22	12·078 363 357 5	52	28·548 858 845
23	12·627 379 873 75	53	29·097 875 361 25
24	13·176 396 39	54	29·646 891 877 5
25	13·725 412 906 25	55	30·195 908 393 75
26	14·274 429 422 5	56	30·744 924 91
27	14·823 445 938 75	57	31·293 941 426 25
28	15·372 462 455	58	31·842 957 942 5
29	15·921 478 971 25	59	32·391 974 458 75
30	16·470 495 487 5	60	32·940 990 975

TABLE XI.—PART IV.

Mean motion of the Moon in longitude in mean solar seconds, from one second to 60; and in decimal parts of seconds from one to 10.

Sec.	′	Sec.	′
1	0·009 150 275 270 8	31	0·283 658 533 394 8
2	0·018 300 550 541 6	32	0·292 808 808 665 6
3	0·027 450 825 812 4	33	0·301 959 083 936 4
4	0·036 601 101 083 2	34	0·311 109 359 207 2
5	0·045 751 376 354	35	0·320 259 634 478
6	0·054 901 651 624 8	36	0·329 409 909 748 8
7	0·064 051 926 895 6	37	0·338 560 185 019 6
8	0·073 202 202 166 4	38	0·347 710 460 290 4
9	0·082 352 477 437 2	39	0·356 860 735 561 2
10	0·091 502 752 708	40	0·366 011 010 832
11	0·100 653 027 978 8	41	0·375 161 286 102 8
12	0·109 803 303 249 6	42	0·384 311 561 373 6
13	0·118 953 578 520 4	43	0·393 461 836 644 4
14	0·128 103 853 791 2	44	0·402 612 111 915 2
15	0·137 254 129 062	45	0·411 762 387 186
16	0·146 404 404 332 8	46	0·420 912 662 456 8
17	0·155 554 679 603 6	47	0·430 062 937 727 6
18	0·164 704 954 874 4	48	0·439 213 212 998 4
19	0·173 855 230 145 2	49	0·448 363 488 269 2
20	0·183 005 505 416	50	0·457 513 763 54
21	0·192 155 780 686 8	51	0·466 664 038 810 8
22	0·201 306 055 957 6	52	0·475 814 314 081 6
23	0·210 456 331 228 4	53	0·484 964 589 352 4
24	0·219 606 606 499 2	54	0·494 114 864 623 2
25	0·228 756 881 77	55	0·503 265 139 894
26	0·237 907 157 040 8	56	0·512 415 415 164 8
27	0·247 057 432 311 6	57	0·521 565 690 435 6
28	0·256 207 707 582 4	58	0·530 715 965 706 4
29	0·265 357 982 853 2	59	0·539 866 240 977 2
30	0·274 508 258 124	60	0·549 016 516 248

Decimal parts of seconds.

Sec.	′
0·1	0·000 915 027 527 08
0·2	0·001 830 055 054 16
0·3	0·002 745 082 581 24
0·4	0·003 660 110 108 32
0·5	0·004 575 137 635 4
0·6	0·005 490 165 162 48
0·7	0·006 405 192 689 56
0·8	0·007 320 220 216 64
0·9	0·008 235 247 743 72
1·0	0·009 150 275 270 8

TABLE XII.—PART I.

Mean motion of the Moon in degrees, reduced to mean solar time, from one degree to 360.

Deg.	Days.	h.	m.	s.
1		1	49	17·179 781 383 2
2		3	38	34·359 562 766 4
3		5	27	51·539 344 149 6
4		7	17	8·719 125 532 8
5		9	6	25·898 906 916 0
6		10	55	43·078 688 299 2
7		12	45	0·258 469 682 4
8		14	34	17·438 251 065 6
9		16	23	34·618 032 448 8
10		18	12	51·797 813 832 0
11		20	2	8·977 595 215 2
12		21	51	26·157 376 598 4
13		23	40	43·337 157 981 6
14	1	1	30	0·516 939 364 8
15	1	3	19	17·696 720 748 0
16	1	5	8	34·876 502 131 2
17	1	6	57	52·056 283 514 4
18	1	8	47	9·236 064 897 6
19	1	10	36	26·415 846 280 8
20	1	12	25	43·595 627 664 0
21	1	14	15	0·775 409 047 2
22	1	16	4	17·955 190 430 4
23	1	17	53	35·134 971 813 6
24	1	19	42	52·314 753 196 8
25	1	21	32	9·494 534 580 0
26	1	23	21	26·674 315 963 2
27	2	1	10	43·854 097 346 4
28	2	3	0	1·033 878 729 6
29	2	4	49	18·213 660 112 8
30	2	6	38	35·393 441 496 0
31	2	8	27	52·573 222 879 2

Deg.	Days.	h.	m.	s.
30	2	6	38	35·393 441 496
60	4	13	17	10·786 882 992
90	6	19	55	46·180 324 488
120	9	2	34	21·573 765 984
150	11	9	12	56·967 207 480
180	13	15	51	32·360 648 976
210	15	22	30	7·754 090 472
240	18	5	8	43·147 531 968
270	20	11	47	18·540 973 464
300	22	18	25	53·934 414 960
330	25	1	4	29·327 856 456
360	27	7	43	4·721 297 952

TABLE XII.—PART II.

Mean motion of the Moon in minutes, and seconds, and decimal parts of seconds, of a degree, reduced to mean solar time.

″	m. (h.)	s. (m.)	th. (s.)	″	m. (h.)	s. (m.)	th. (s.)
′				′			
1		1	49·286 329 689 72	31		56	27·876 220 381 32
2		3	38·572 659 379 44	32		58	17·162 550 071 04
3		5	27·858 989 069 16	33	1	0	6·448 879 760 76
4		7	17·145 318 758 88	34	1	1	55·735 209 450 48
5		9	6·431 648 448 60	35	1	3	45·021 539 140 20
6		10	55·717 978 138 32	36	1	5	34·307 868 829 92
7		12	45·004 307 828 04	37	1	7	23·594 198 519 64
8		14	34·290 637 517 76	38	1	9	12·880 528 209 36
9		16	23·576 967 207 48	39	1	11	2·166 857 899 08
10		18	12·863 296 897 20	40	1	12	51·453 187 588 80
11		20	2·149 626 586 92	41	1	14	40·739 517 278 52
12		21	51·435 956 276 64	42	1	16	30·025 846 968 24
13		23	40·722 285 966 36	43	1	18	19·312 176 657 96
14		25	30·008 615 656 08	44	1	20	8·598 506 347 68
15		27	19·294 945 345 80	45	1	21	57·884 836 037 40
16		29	8·581 275 035 52	46	1	23	47·171 165 727 12
17		30	57·867 604 725 24	47	1	25	36·457 495 416 84
18		32	47·153 934 414 96	48	1	27	25·743 825 106 56
19		34	36·440 264 104 68	49	1	29	15·030 154 796 28
20		36	25·726 593 794 40	50	1	31	4·316 484 486 00
21		38	15·012 923 484 12	51	1	32	53·602 814 175 72
22		40	4·299 253 173 84	52	1	34	42·889 143 865 44
23		41	53·585 582 863 56	53	1	36	32·175 473 555 16
24		43	42·871 912 553 28	54	1	38	21·461 803 244 88
25		45	32·158 242 243 00	55	1	40	10·748 132 934 60
26		47	21·444 571 932 72	56	1	42	0·034 462 624 32
27		49	10·730 901 622 44	57	1	43	49·320 792 314 04
28		51	0·017 231 312 16	58	1	45	38·607 122 003 76
29		52	49·303 561 001 88	59	1	47	27·893 451 693 48
30		54	38·589 890 691 60	60	1	49	17·179 781 383 20

Decimal parts of a second.

″	s.	th.	s.	″	s.	th.	s.
0·1		10·928 632 968 972	=0·182 1	0·6	1	5·571 797 813 832	=1·092 9
0·2		21·857 265 937 944	=0·364 3	0·7	1	16·500 430 782 804	=1·275
0·3		32·785 898 906 916	=0·546 4	0·8	1	27·429 063 751 776	=1·457 1
0·4		43·714 531 875 888	=0·728 6	0·9	1	38·357 696 720 748	=1·639 3
0·5		54·643 164 844 860	=0·910 7	1·0	1	49·286 329 689 720	=1·821 4

TABLE XIII.

Mean motion of the Moon in longitude in the Equable year, Cyclical or Nabonassarian, from one to 7000 equable years.

MERIDIAN OF GREENWICH.

Æra Cyc.	Nab.		A. M.	A. D.	°	′	″
5808–5809	2549–2550	Mesore 10=(May 4	5805	1801)	97	5	56·945 54

Secular correction, see Table xiv.

Equable Years.	Revolutions.	°	′	″
1	13	129	23	4·856 46
2	26	258	46	9·712 92
3	40	28	9	14·569 38
4	53	157	32	19·425 84
5	66	286	55	24·282 30
6	80	56	18	29·138 76
7	93	185	41	33·995 22
8	106	315	4	38·851 68
9	120	84	27	43·708 14
10	133	213	50	48·564 60
20	267	67	41	37·129 2
30	400	281	32	25·693 8
40	534	135	23	14·258 4
50	667	349	14	2·823 0
60	801	203	4	51·387 6
70	935	56	55	39·952 2
80	1,068	270	46	28·516 8
90	1,202	124	37	17·081 4
100	1,335	338	28	5·646 0
200	2,671	316	56	11·292
300	4,007	295	24	16·938
400	5,343	273	52	22·584
500	6,679	252	20	28·230
600	8,015	230	48	33·876
700	9,351	209	16	39·522
800	10,687	187	44	45·168
900	12,023	166	12	50·814
1000	13,359	144	40	56·460
2000	26,718	289	21	52·92
3000	40,078	74	2	49·38
4000	53,437	218	43	45·84
5000	66,797	3	24	42·30
6000	80,156	148	5	38·76
7000	93,515	292	46	35·22

TABLE XIV.

Mean motion of the Moon in longitude in the mean Julian year, from one to 7000 mean Julian years.

MERIDIAN OF GREENWICH.

Cycle of leap-yr.	A. M.	A. D.	Mean noon.	°	′	″
2	5805	1801	April 29	31	13	1·810 52
3	5806	1802	April 29	160	36	6·666 98
4	5807	1803	April 29	289	59	11·523 44
1	5808	1804	April 29	72	32	51·406 904

Secular correction, $+(10''\cdot723\,2\,\kappa^2 - 0''\cdot019\,361\,\kappa^3)$ before A. D. 1801.
.. .. $+(10''\cdot723\,2\,\kappa^2 + 0''\cdot019\,361\,\kappa^3)$ after A. D. 1801.

Julian Years.	Revolutions.	°	′	″
1	13	132	40	43·613 211
2	26	265	21	27·226 422
3	40	38	2	10·839 633
4	53	170	42	54·452 844
5	66	303	23	38·066 055
6	80	76	4	21·679 266
7	93	208	45	5·292 477
8	106	341	25	48·905 688
9	120	114	6	32·518 899
10	133	246	47	16·132 11
20	267	133	34	32·264 22
30	401	20	21	48·396 33
40	534	267	9	4·528 44
50	668	153	56	20·660 55
60	802	40	43	36·792 66
70	935	287	30	52·924 77
80	1,069	174	18	9·056 88
90	1,203	61	5	25·188 99
100	1,336	307	52	41·321 1
200	2,673	255	45	22·642 2
300	4,010	203	38	3·963 3
400	5,347	151	30	45·284 4
500	6,684	99	23	26·605 5
600	8,021	47	16	7·926 6
700	9,357	355	8	49·247 7
800	10,694	303	1	30·568 8
900	12,031	250	54	11·889 9
1000	13,368	198	46	53·211
2000	26,737	37	33	46·422
3000	40,105	236	20	39·633
4000	53,474	75	7	32·844
5000	66,842	273	54	26·055
6000	80,211	112	41	19·266
7000	93,579	311	28	12·477

TABLE XV.—Part I.

Mean motion of the Lunar Perigee in mean solar days, from one day to 365.

Days.	°	′	″
1	..	6	41·055 894
2	..	13	22·111 788
3	..	20	3·167 682
4	..	26	44·223 576
5	..	33	25·279 470
6	..	40	6·335 364
7	..	46	47·391 258
8	..	53	28·447 152
9	1	0	9·503 046
10	1	6	50·558 940
11	1	13	31·614 834
12	1	20	12·670 728
13	1	26	53·726 622
14	1	33	34·782 516
15	1	40	15·838 410
16	1	46	56·894 304
17	1	53	37·950 198
18	2	0	19·006 092
19	2	7	0·061 986
20	2	13	41·117 880
21	2	20	22·173 774
22	2	27	3·229 668
23	2	33	44·285 562
24	2	40	25·341 456
25	2	47	6·397 350
26	2	53	47·453 244
27	3	0	28·509 138
28	3	7	9·565 032
29	3	13	50·620 926
30	3	20	31·676 820
31	3	27	12·732 714

Months	Days.	°	′	″
1	30	3	20	31·676 82
2	60	6	41	3·353 64
3	90	10	1	35·030 46
4	120	13	22	6·707 28
5	150	16	42	38·384 10
6	180	20	3	10·060 92
7	210	23	23	41·737 74
8	240	26	44	13·414 56
9	270	30	4	45·091 38
10	300	33	25	16·768 20
11	330	36	45	48·445 02
12	360	40	6	20·121 84
	5		33	25·279 47
	365	40	39	45·401 31

TABLE XV.—Part II.

Mean motion of the Lunar Perigee in mean solar hours, from one hour to 24.

Hours.	′	″
1	..	16·710 662 25
2	..	33·421 324 50
3	..	50·131 986 75
4	1	6·842 649 00
5	1	23·553 311 25
6	1	40·263 973 50
7	1	56·974 635 75
8	2	13·685 298 00
9	2	30·395 960 25
10	2	47·106 622 50
11	3	3·817 284 75
12	3	20·527 947 00
13	3	37·238 609 25
14	3	53·949 271 50
15	4	10·659 933 75
16	4	27·370 596 00
17	4	44·081 258 25
18	5	0·791 920 50
19	5	17·502 582 75
20	5	34·213 245 00
21	5	50·923 907 25
22	6	7·634 569 50
23	6	24·345 231 75
24	6	41·055 894

TABLE XV.—Part III.

Mean motion of the Lunar Perigee in mean solar minutes, from one minute to 60.

Min.	″	Min.	″
1	0·278 511 037 5	31	8·633 842 162 5
2	0·557 022 075	32	8·912 353 2
3	0·835 533 112 5	33	9·190 864 237 5
4	1·114 044 150	34	9·469 375 275
5	1·392 555 187 5	35	9·747 886 312 5
6	1·671 066 225	36	10·026 397 35
7	1·949 577 262 5	37	10·304 908 387 5
8	2·228 088 3	38	10·583 419 425
9	2·506 599 337 5	39	10·861 930 462 5
10	2·785 110 375	40	11·140 441 5
11	3·063 621 412 5	41	11·418 952 537 5
12	3·342 132 45	42	11·697 463 575
13	3·620 643 487 5	43	11·975 974 612 5
14	3·899 154 525	44	12·254 485 65
15	4·177 665 562 5	45	12·532 996 687 5
16	4·456 176 6	46	12·811 507 725
17	4·734 687 637 5	47	13·090 018 762 5
18	5·013 198 675	48	13·368 529 8
19	5·291 709 712 5	49	15·647 040 837 5
20	5·570 220 75	50	13·925 551 875
21	5·848 731 787 5	51	14·204 062 912 5
22	6·127 242 825	52	14·482 573 95
23	6·405 753 862 5	53	14·761 084 987 5
24	6·684 264 9	54	15·039 596 025
25	6·962 775 937 5	55	15·318 107 062 5
26	7·241 286 975	56	15·596 618 1
27	7·519 798 012 5	57	15·875 129 137 5
28	7·798 309 05	58	16·153 640 175
29	8·076 820 087 5	59	16·432 151 212 5
30	8·355 331 125	60	16·710 662 25

TABLE XV.—Part IV.

Mean motion of the Lunar Perigee in mean solar seconds, from one second to 60.

Sec.	″	Sec.	″
1	0·004 641 850 625	31	0·143 897 369 375
2	0·009 283 701 25	32	0·148 539 22
3	0·013 925 551 875	33	0·153 181 070 625
4	0·018 567 402 5	34	0·157 822 921 25
5	0·023 209 253 125	35	0·162 464 771 875
6	0·027 851 103 75	36	0·167 106 622 5
7	0·032 492 954 375	37	0·171 748 473 125
8	0·037 134 805	38	0·176 390 323 75
9	0·041 776 655 625	39	0·181 032 174 375
10	0·046 418 506 25	40	0·185 674 025
11	0·051 060 356 875	41	0·190 315 875 625
12	0·055 702 207 5	42	0·194 957 726 25
13	0·060 344 058 125	43	0·199 599 576 875
14	0·064 985 908 75	44	0·204 241 427 5
15	0·069 627 759 375	45	0·208 883 278 125
16	0·074 269 61	46	0·213 525 128 75
17	0·078 911 460 625	47	0·218 166 979 375
18	0·083 553 311 25	48	0·222 808 83
19	0·088 195 161 875	49	0·227 450 680 625
20	0·092 837 012 5	50	0·232 092 531 25
21	0·097 478 863 125	51	0·236 734 381 875
22	0·102 120 713 75	52	0·241 376 232 5
23	0·106 762 564 375	53	0·246 018 083 125
24	0·111 404 415	54	0·250 659 933 75
25	0·116 046 265 625	55	0·255 301 784 375
26	0·120 688 116 25	56	0·259 943 635
27	0·125 329 966 875	57	0·264 585 485 625
28	0·129 971 817 5	58	0·269 227 336 25
29	0·134 613 668 125	59	0·273 869 186 875
30	0·139 255 518 75	60	0·278 511 037 5

TABLE XVI.

Mean motion of the Lunar Perigee in the Equable year, Cyclical or Nabonassarian, from one to 7000 equable years.

MERIDIAN OF GREENWICH.

Æra Cyc.	Nab.	Mean noon.	A.M.	A.D.	° ′ ″
5808–5809	2549–2550	Mesore 10 = May 4	5805	1801	281 12 30·045 69.

Secular correction, see Table xvii.

Equable years.	Revolutions.	°	′	″
1		40	39	45·402 034 5
2		81	19	30·804 069
3		121	59	16·206 103 5
4		162	39	1·608 138
5		203	18	47·010 172 5
6		243	58	32·412 207
7		284	38	17·814 241 5
8		325	18	3·216 276
9	1	5	57	48·618 310 5
10	1	46	37	34·020 345
20	2	93	15	8·040 69
30	3	139	52	42·061 035
40	4	186	30	16·081 38
50	5	233	7	50·101 725
60	6	279	45	24·122 07
70	7	326	22	58·142 415
80	9	13	0	32·162 76
90	10	59	38	6·183 105
100	11	106	15	40·203 45
200	22	212	31	20·406 9
300	33	318	47	0·610 35
400	45	65	2	40·813 8
500	56	171	18	21·017 25
600	67	277	34	1·220 7
700	79	23	49	41·424 15
800	90	130	5	21·627 6
900	101	236	21	1·831 05
1000	112	342	36	42·034 5
2000	225	325	13	24·069
3000	338	307	50	6·103 5
4000	451	290	26	48·138
5000	564	273	3	30·172 5
6000	677	255	40	12·207
7000	790	238	16	54·241 5

TABLE XVII.

Mean motion of the Lunar Perigee in the mean Julian year, from one to 7000 mean Julian years.

MERIDIAN OF GREENWICH.

Cycle of leap-yr.	A.M.	A.D.	Mean noon.	°	′	″
2	5805	1801	April 29	280	39	4·766 22
3	5806	1802	April 29	321	18	50·168 254 5
4	5807	1803	April 29	1	58	35·570 289
1	5808	1804	April 29	42	45	2·028 217 5

Secular correction, $-(39''\cdot 697\ 1\ \kappa^2 - 0''\cdot 071\ 674\ \kappa^3)$ before A.D. 1801.
.. .. $-(39''\cdot 697\ 1\ \kappa^2 + 0''\cdot 071\ 674\ \kappa^3)$ after A.D. 1801.

Julian Years.	Revolutions.	°	′	″
1		40	41	25·666 008
2		81	22	51·332 016
3		122	4	16·998 024
4		162	45	42·664 032
5		203	27	8·330 040
6		244	8	33·996 048
7		284	49	59·662 056
8		325	31	25·328 064
9	1	6	12	50·994 072
10	1	46	54	16·660 08
20	2	93	48	33·320 16
30	3	140	42	49·980 24
40	4	187	37	6·640 32
50	5	234	31	23·300 40
60	6	281	25	39·960 48
70	7	328	19	56·620 56
80	9	15	14	13·280 64
90	10	62	8	29·940 72
100	11	109	2	46·600 8
200	22	218	5	33·201 6
300	33	327	8	19·802 4
400	45	76	11	6·403 2
500	56	185	13	53·004 0
600	67	294	16	39·604 8
700	79	43	19	26·205 6
800	90	152	22	12·806 4
900	101	261	24	59·407 2
1000	113	10	27	46·008
2000	226	20	55	32·016
3000	339	31	23	18·024
4000	452	41	51	4·032
5000	565	52	18	50·040
6000	678	62	46	36·048
7000	791	73	14	22·056

TABLE XVIII.—Part I.

Mean motion of the Moon's Ascending Node in mean solar days, from one day to 365 days.

Days.	°	′	″	Days.	°	′	″
1		3	10·636 480 8	30	1	35	19·094 424
2		6	21·272 961 6	60	3	10	38·188 848
3		9	31·909 442 4	90	4	45	57·283 272
4		12	42·545 923 2	120	6	21	16·377 696
5		15	53·182 404	150	7	56	35·472 120
6		19	3·818 884 8	180	9	31	54·566 544
7		22	14·455 365 6	210	11	7	13·660 968
8		25	25·091 846 4	240	12	42	32·755 392
9		28	35·728 327 2	270	14	17	51·849 816
10		31	46·364 808	300	15	53	10·944 24
11		34	57·001 288 8	330	17	28	30·038 664
12		38	7·637 769 6	360	19	3	49·133 088
13		41	18·274 250 4	365	19	19	42·315 492
14		44	28·910 731 2	365d 6h	19	20	29·974 612 2
15		47	39·547 212				
16		50	50·183 692 8				
17		54	0·820 173 6				
18		57	11·456 654 4				
19	1	0	22·093 135 2				
20	1	3	32·729 616				
21	1	6	43·366 096 8				
22	1	9	54·002 577 6				
23	1	13	4·639 058 4				
24	1	16	15·275 539 2				
25	1	19	25·912 02				
26	1	22	36·548 500 8				
27	1	25	47·184 981 6				
28	1	28	57·821 462 4				
29	1	32	8·457 943 2				
30	1	35	19·094 424				
31	1	38	29·730 904 8				

TABLE XVIII.—Part II.

Mean motion of the Moon's Ascending Node in mean solar hours, from one hour to 24.

Hours.	′	″
1		7·943 186 7
2		15·886 373 4
3		23·829 560 1
4		31·772 746 8
5		39·715 933 5
6		47·659 120 2
7		55·602 306 9
8	1	3·545 493 6
9	1	11·488 680 3
10	1	19·431 867
11	1	27·375 053 7
12	1	35·318 240 4
13	1	43·261 427 1
14	1	51·204 613 8
15	1	59·147 800 5
16	2	7·090 987 2
17	2	15·034 173 9
18	2	22·977 360 6
19	2	30·920 547 3
20	2	38·863 734
21	2	46·806 920 7
22	2	54·750 107 4
23	3	2·693 294 1
24	3	10·636 480 8

TABLE XVIII.—Part III.

Mean motion of the Moon's Ascending Node in mean solar minutes, from one minute to 60.

Min.	"	Min.	"
1	0·132 386 445	31	4·103 979 795
2	0·264 772 89	32	4·236 366 24
3	0·397 159 335	33	4·368 752 685
4	0·529 545 78	34	4·501 139 13
5	0·661 932 225	35	4·633 525 575
6	0·794 318 67	36	4·765 912 02
7	0·926 705 115	37	4·898 298 465
8	1·059 091 56	38	5·030 684 91
9	1·191 478 005	39	5·163 071 355
10	1·323 864 45	40	5·295 457 8
11	1·456 250 895	41	5·427 844 245
12	1·588 637 34	42	5·560 230 69
13	1·721 023 785	43	5·692 617 135
14	1·853 410 23	44	5·825 003 58
15	1·985 796 675	45	5·957 390 025
16	2·118 183 12	46	6·089 776 47
17	2·250 569 565	47	6·222 162 915
18	2·382 956 01	48	6·354 549 36
19	2·515 342 455	49	6·486 935 805
20	2·647 728 9	50	6·619 322 25
21	2·780 115 345	51	6·751 708 695
22	2·912 501 79	52	6·884 095 14
23	3·044 888 235	53	7·016 481 585
24	3·177 274 68	54	7·148 868 03
25	3·309 661 125	55	7·281 254 475
26	3·442 047 57	56	7·413 640 92
27	3·574 434 015	57	7·546 027 365
28	3·706 820 46	58	7·678 413 81
29	3·839 206 905	59	7·810 800 255
30	3·971 593 35	60	7·943 186 7

TABLE XVII.—Part IV.

Mean motion of the Moon's Ascending Node in mean solar seconds, from one second to 60.

Sec.	"	Sec.	"
1	0·002 206 440 75	31	0·068 399 663 25
2	0·004 412 881 5	32	0·070 606 104
3	0·006 619 322 25	33	0·072 812 544 75
4	0·008 825 763	34	0·075 018 985 5
5	0·011 032 203 75	35	0·077 225 426 25
6	0·013 238 644 5	36	0·079 431 867
7	0·015 445 085 25	37	0·081 638 307 75
8	0·017 651 526	38	0·083 844 748 5
9	0·019 857 966 75	39	0·086 051 189 25
10	0·022 064 407 5	40	0·088 257 63
11	0·024 270 848 25	41	0·090 464 070 75
12	0·026 477 289	42	0·092 670 511 5
13	0·028 683 729 75	43	0·094 876 952 25
14	0·030 890 170 5	44	0·097 083 393
15	0·033 096 611 25	45	0·099 289 833 75
16	0·035 303 052	46	0·101 496 274 5
17	0·037 509 492 75	47	0·103 702 715 25
18	0·039 715 933 5	48	0·105 909 156
19	0·041 922 374 25	49	0·108 115 596 75
20	0·044 128 815	50	0·110 322 037 5
21	0·046 335 255 75	51	0·112 528 478 25
22	0·048 541 696 5	52	0·114 734 919
23	0·050 748 137 25	53	0·116 941 359 75
24	0·052 954 578	54	0·119 147 800 5
25	0·055 161 018 75	55	0·121 354 241 25
26	0·057 367 459 5	56	0·123 560 682
27	0·059 573 900 25	57	0·125 767 122 75
28	0·061 780 341	58	0·127 973 563 5
29	0·063 986 781 75	59	0·130 180 004 25
30	0·066 193 222 5	60	0·132 386 445

TABLE XIX.

Mean motion of the Moon's Ascending Node in the Equable year, Cyclical or Nabonassarian, from one to 7000 equable years.

EPOCH, MERIDIAN OF GREENWICH, MEAN NOON.

Æra Cyc.	Nab.	Mean noon.	A. M.	A. D.	°	′	″
5808–5809	2549–2550	Mesore 10 = May 4	5805	1801	6	44	21·775 092

Secular correction, see Table xx.

Equable Years.	Revolutions.	°	′	″
1	..	19	19	42·315 879
2	..	38	39	24·631 758
3	..	57	59	6·947 637
4	..	77	18	49·263 516
5	..	96	38	31·579 395
6	..	115	58	13·895 274
7	..	135	17	56·211 153
8	..	154	37	38·527 032
9	..	173	57	20·842 911
10	..	193	17	3·158 79
20	1	26	34	6·317 58
30	1	219	51	9·476 37
40	2	53	8	12·635 16
50	2	246	25	15·793 95
60	3	79	42	18·952 74
70	3	272	59	22·111 53
80	4	106	16	25·270 32
90	4	299	33	28·429 11
100	5	132	50	31·587 9
200	10	265	41	3·175 8
300	16	38	31	34·763 7
400	21	171	22	6·351 6
500	26	304	12	37·939 5
600	32	77	3	9·527 4
700	37	209	53	41·115 3
800	42	342	44	12·703 2
900	48	115	34	44·291 1
1000	53	248	25	15·879
2000	107	136	50	31·758
3000	161	25	15	47·637
4000	214	273	41	3·516
5000	268	162	6	19·395
6000	322	50	31	35·274
7000	375	298	56	51·153

TABLE XX.

Mean motion of the Moon's Ascending Node in the mean Julian year, from one to 7000 mean Julian years.

EPOCHS, MERIDIAN OF GREENWICH.

Cycle of leap-yr.	A.M.	A.D.		°	′	″	
2	5805	1801	April 29	7	0	14·957 496	Mean noon.
3	5806	1802	April 29	347	40	32·641 617	—
4	5807	1803	April 29	328	20	50·325 738	—
1	5808	1804	April 29	308	57	57·373 378	—

Secular correction, $-$ ($6''\cdot563\,2\,\kappa^2 - 0''\cdot011\,850\,\kappa^2$) before A. D. 1801.
.. .. $-$ ($6''\cdot563\,2\,\kappa^2 + 0''\cdot011\,850\,\kappa^3$) after A. D. 1801.

Julian Years.	Revolutions.	°	′	″
1	..	19	20	29·974 999 2
2	..	38	40	59·949 998 4
3	..	58	1	29·924 997 6
4	..	77	21	59·899 996 8
5	..	96	42	29·874 996
6	..	116	2	59·849 995 2
7	..	135	23	29·824 994 4
8	..	154	43	59·799 993 6
9	..	174	4	29·774 992 8
10	..	193	24	59·749 992
20	1	26	49	59·499 984
30	1	220	14	59·249 976
40	2	53	39	58·999 968
50	2	247	4	58·749 96
60	3	80	29	58·499 952
70	3	273	54	58·249 944
80	4	107	19	57·999 936
90	4	300	44	57·749 928
100	5	134	9	57·499 92
200	10	268	19	54·999 84
300	16	42	29	52·499 76
400	21	176	39	49·999 68
500	26	310	49	47·499 6
600	32	84	59	44·999 52
700	37	219	9	42·499 44
800	42	353	19	39·999 36
900	48	127	29	37·499 28
1000	53	261	39	34·999 2
2000	107	163	19	9·998 4
3000	161	64	58	44·997 6
4000	214	326	38	19·996 8
5000	268	228	17	54·996
6000	322	129	57	29·995 2
7000	376	31	37	4·994 4

TABLE XXI. PART I.—*The Annual, or first, Equation of the mean to the true Syzygy.*

Argument, The Sun's mean anomaly.

SUBTRACT.

	Signs 0	Sign I	Signs 2	Signs 3	Signs 4	Signs 5	
Deg.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	
0	0 0 0	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	30
1	0 4 18	2 6 55	3 37 10	4 10 57	3 37 19	2 3 55	29
2	0 8 35	2 10 36	3 39 18	4 10 55	3 35 6	2 0 1	28
3	0 12 51	2 14 14	3 41 23	4 10 49	3 32 50	1 56 5	27
4	0 17 8	2 17 52	3 43 26	4 10 39	3 30 30	1 52 6	26
5	0 21 24	2 21 27	3 45 25	4 10 24	3 28 5	1 48 4	25
6	0 25 39	2 25 9	3 47 19	4 10 4	3 25 35	1 41 1	24
7	0 28 55	2 28 29	3 49 7	4 9 39	3 23 0	1 39 56	23
8	0 34 11	2 31 57	3 50 50	4 9 10	3 20 20	1 35 49	22
9	0 38 26	2 35 22	3 52 29	4 8 37	3 17 35	1 31 41	21
10	0 42 39	2 38 44	3 54 4	4 7 59	3 14 49	1 27 31	20
11	0 46 52	2 42 3	3 55 35	4 7 16	3 11 59	1 23 19	19
12	0 51 4	2 45 18	3 57 2	4 6 29	3 9 6	1 19 5	18
13	0 55 17	2 48 30	3 58 27	4 5 37	3 6 10	1 14 49	17
14	0 59 27	2 51 40	3 59 49	4 4 41	3 3 10	1 10 33	16
15	1 3 36	2 54 48	3 1 7	4 3 40	3 0 7	1 6 15	15
16	1 7 45	2 57 53	4 2 18	4 2 35	2 57 0	1 1 56	14
17	1 11 53	3 0 54	4 3 23	4 1 26	2 53 49	0 57 36	13
18	1 16 0	3 3 51	4 4 22	4 0 12	2 50 36	0 53 15	12
19	1 20 6	3 6 45	4 5 18	3 58 52	2 47 18	0 48 52	11
20	1 24 10	3 9 36	4 6 10	3 57 27	2 43 57	0 44 28	10
21	1 28 12	3 12 24	4 6 58	3 55 59	2 40 33	0 40 2	9
22	1 32 12	3 15 9	4 7 41	3 54 26	2 37 6	0 35 36	8
23	1 36 10	3 17 51	4 8 21	3 52 49	2 33 35	0 31 10	7
24	1 40 6	3 20 30	4 8 57	3 51 9	2 30 2	0 26 44	6
25	1 44 1	3 23 5	4 9 29	3 49 26	2 26 26	0 22 17	5
26	1 47 54	3 25 36	4 9 55	3 47 38	2 22 47	0 17 50	4
27	1 51 46	3 28 3	4 10 16	3 45 44	2 19 5	0 13 23	3
28	1 55 37	3 30 26	4 10 33	3 43 45	2 15 20	0 8 56	2
29	1 59 26	3 32 45	4 10 45	3 41 40	2 11 35	0 4 29	1
30	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	0 0 0	0
	Signs 11	10	9	8	7	6	Deg.

ADD.

TABLE XXI. PART II.—*Equation of the Moon's mean anomaly.*

Argument, The Sun's mean anomaly.

SUBTRACT.

	Signs 0	Sign I	Signs 2	Signs 3	Signs 4	Signs 5	
Deg.	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	
0	0 0 0	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	30
1	0 1 37	0 48 10	1 22 21	1 35 2	1 22 14	0 46 51	29
2	0 3 13	0 49 34	1 23 10	1 35 1	1 21 24	0 45 23	28
3	0 4 52	0 50 53	1 23 57	1 35 0	1 20 32	0 43 54	27
4	0 6 28	0 52 19	1 24 41	1 34 57	1 19 38	0 42 24	26
5	0 8 6	0 53 40	1 25 24	1 34 50	1 18 42	0 40 53	25
6	0 9 42	0 55 0	1 26 6	1 34 43	1 17 45	0 39 21	24
7	0 11 20	0 56 21	1 26 48	1 34 33	1 16 48	0 37 49	23
8	0 12 56	0 57 38	1 27 28	1 34 22	1 15 47	0 36 15	22
9	0 14 33	0 58 56	1 28 6	1 34 9	1 14 44	0 34 40	21
10	0 16 10	1 0 13	1 28 43	1 33 53	1 13 41	0 33 5	20
11	0 17 47	1 1 29	1 29 17	1 33 37	1 12 37	0 31 31	19
12	0 19 23	1 2 43	1 29 51	1 33 20	1 11 33	0 29 54	18
13	0 20 59	1 3 56	1 30 22	1 33 0	1 10 26	0 28 18	17
14	0 22 35	1 5 8	1 30 50	1 32 38	1 9 17	0 26 40	16
15	0 24 10	1 6 18	1 31 19	1 32 14	1 8 8	0 25 3	15
16	0 25 45	1 7 27	1 31 45	1 31 50	1 6 58	0 23 23	14
17	0 27 19	1 8 36	1 32 12	1 31 23	1 5 46	0 21 45	13
18	0 28 52	1 9 42	1 32 34	1 30 55	1 4 32	0 20 7	12
19	0 30 25	1 10 49	1 32 57	1 30 25	1 3 19	0 18 28	11
20	0 31 57	1 11 54	1 33 17	1 29 54	1 2 1	0 16 48	10
21	0 33 29	1 12 58	1 33 36	1 29 20	1 0 45	0 15 8	9
22	0 35 2	1 14 1	1 33 52	1 28 45	0 59 26	0 13 28	8
23	0 36 32	1 15 1	1 34 6	1 28 9	0 58 7	0 11 48	7
24	0 38 1	1 16 0	1 34 18	1 27 30	0 56 45	0 10 7	6
25	0 39 29	1 16 59	1 34 30	1 26 50	0 55 23	0 8 20	5
26	0 40 59	1 17 57	1 34 40	1 26 27	0 54 1	0 6 44	4
27	0 42 26	1 18 52	1 34 48	1 25 5	0 52 37	0 5 3	3
28	0 43 54	1 19 47	1 34 54	1 24 39	0 51 12	0 3 21	2
29	0 45 19	1 20 40	1 34 58	1 23 52	0 49 45	0 1 40	1
30	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	0 0 0	0
	Signs 11	10	9	8	7	6	Deg.

ADD.

TABLE XXI. PART III.—*Second Equation of the mean to the true Syzygy.*

Argument, The Moon's equated anomaly.

ADD.

	Signs 0	Sign 1	Signs 2	Signs 3	Signs 4	Signs 5	
Deg.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	
0	0 0 0	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	30
1	0 10 58	5 21 56	8 51 45	9 45 3	8 3 12	4 26 1	29
2	0 21 56	5 30 57	8 56 10	9 45 12	7 57 23	4 17 25	28
3	0 32 54	5 39 51	9 0 25	9 44 11	7 51 33	4 8 47	27
4	0 43 52	5 48 37	9 4 31	9 42 59	7 45 46	4 0 7	26
5	0 54 50	5 57 17	9 8 25	9 41 36	7 39 46	3 51 23	25
6	1 5 48	6 5 51	9 12 9	9 40 3	7 33 36	3 42 32	24
7	1 16 46	6 14 19	9 15 43	9 38 19	7 27 22	3 33 38	23
8	1 27 44	6 22 41	9 19 5	9 36 24	7 21 2	3 24 42	22
9	1 38 40	6 30 57	9 22 14	9 34 18	7 14 30	3 15 44	21
10	1 49 33	6 39 4	9 23 12	9 32 1	7 7 50	3 6 45	20
11	2 0 23	6 47 0	9 27 54	9 29 33	7 1 2	2 57 43	19
12	2 11 10	6 54 46	9 30 32	9 26 54	6 54 8	2 48 39	18
13	2 21 54	7 2 24	9 32 58	9 24 4	6 47 9	2 39 34	17
14	2 32 34	7 9 52	9 35 12	9 21 3	6 40 6	2 30 28	16
15	2 43 9	7 17 9	9 37 14	9 17 51	6 32 56	2 21 19	15
16	2 53 38	7 24 19	9 39 8	9 14 28	6 25 40	2 12 8	14
17	3 4 3	7 31 18	9 40 51	9 10 54	6 18 18	2 2 53	13
18	3 14 24	7 38 9	9 42 21	9 7 9	6 10 49	1 53 36	12
19	3 24 42	7 44 51	9 43 42	9 3 13	6 3 16	1 44 16	11
20	3 34 58	7 51 24	9 44 53	8 59 6	5 55 38	1 34 54	10
21	3 45 11	7 57 45	9 45 52	8 54 50	5 47 54	1 25 31	9
22	3 55 21	8 3 56	9 46 38	8 50 24	5 40 4	1 16 7	8
23	4 5 26	8 9 57	9 47 13	8 45 48	5 32 9	1 6 41	7
24	4 15 26	8 15 46	9 47 36	8 41 2	5 24 9	0 57 13	6
25	4 25 20	8 21 24	9 47 49	8 36 6	5 16 5	0 47 44	5
26	4 35 6	8 26 53	9 47 54	8 31 0	5 7 56	0 38 13	4
27	4 44 42	8 32 11	9 47 46	8 25 44	4 59 42	0 28 41	3
28	4 54 11	8 37 19	9 47 33	8 20 18	4 51 15	0 19 8	2
29	5 3 33	8 42 18	9 47 14	8 14 33	4 43 2	0 9 34	1
30	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	0 0 3	0
	Signs 11	10	9	8	7	6	Deg.

SUBTRACT.

TABLE XXI. PART IV.—*The third Equation of the mean to the true Syzygy.*

Argument, Sun's anomaly—Moon's equated anomaly.

	Signs 0 Sub. 6 Add	Signs 1 Sub. 7 Add	Signs 2 Sub. 8 Add	
Deg.	m. s.	m. s.	m. s.	
0	0 0	2 22	4 12	30
1	0 5	2 26	4 15	29
2	0 10	2 30	4 18	28
3	0 15	2 34	4 21	27
4	0 20	2 38	4 24	26
5	0 25	2 42	4 27	25
6	0 30	2 46	4 30	24
7	0 35	2 50	4 32	23
8	0 40	2 54	4 34	22
9	0 45	2 58	4 36	21
10	0 50	3 2	4 38	20
11	0 55	3 6	4 40	19
12	1 0	3 10	4 42	18
13	1 5	3 14	4 44	17
14	1 10	3 18	4 46	16
15	1 15	3 22	4 48	15
16	1 20	3 26	4 50	14
17	1 25	3 30	4 51	13
18	1 30	3 34	4 52	12
19	1 35	3 38	4 53	11
20	1 40	3 42	4 54	10
21	1 45	3 45	4 55	9
22	1 49	3 48	4 56	8
23	1 52	3 51	4 57	7
24	1 56	3 54	4 57	6
25	2 0	3 57	4 57	5
26	2 4	4 0	4 58	4
27	2 9	4 3	4 58	3
28	2 13	4 6	4 58	2
29	2 18	4 9	4 58	1
30	2 22	4 12	4 58	0
	Signs 5 Sub. 11 Add	Signs 4 Sub. 10 Add	Signs 3 Sub. 9 Add	Deg.

TABLE XXI. PART V.—*The fourth Equation of the mean to the true Syzygy.*

Argument, Sun's mean distance from the node.

ADD.

	0, 6 Signs.	1, 7 Signs.	2, 8 Signs.	
Deg.	m. s.	m. s.	m. s.	
0	0 0	1 22	1 22	30
1	0 4	1 23	1 21	29
2	0 7	1 24	1 20	28
3	0 10	1 25	1 18	27
4	0 13	1 26	1 16	26
5	0 16	1 27	1 14	25
6	0 20	1 28	1 12	24
7	0 23	1 29	1 10	23
8	0 26	1 30	1 8	22
9	0 29	1 31	1 6	21
10	0 32	1 32	1 3	20
11	0 35	1 33	1 0	19
12	0 38	1 33	0 57	18
13	0 41	1 34	0 54	17
14	0 44	1 34	0 51	16
15	0 47	1 34	0 49	15
16	0 50	1 34	0 45	14
17	0 52	1 34	0 41	13
18	0 54	1 34	0 37	12
19	0 57	1 33	0 34	11
20	1 0	1 33	0 31	10
21	1 2	1 32	0 28	9
22	1 5	1 31	0 25	8
23	1 8	1 30	0 22	7
24	1 10	1 29	0 19	6
25	1 12	1 28	0 16	5
26	1 14	1 27	0 13	4
27	1 16	1 26	0 10	3
28	1 18	1 25	0 6	2
29	1 20	1 24	0 3	1
30	1 22	1 22	0 0	0
	5, 11 Signs.	4, 10 Signs.	3, 9 Signs.	Deg.

SUBTRACT.

TABLE XXI. PART VI.—*Equation of the Sun's mean distance from the node.*

Argument, The Sun's mean anomaly.

SUBTRACT.

	Signs 0	Sign 1	Signs 2	Signs 3	Signs 4	Signs 5	
Deg.	° '	° '	° '	° '	° '	° '	
0	0 0	1 2	1 47	2 5	1 50	1 4	30
1	0 2	1 4	1 48	2 5	1 48	1 2	29
2	0 4	1 6	1 49	2 5	1 47	1 0	28
3	0 6	1 8	1 50	2 5	1 46	0 58	27
4	0 9	1 10	1 51	2 5	1 45	0 56	26
5	0 11	1 12	1 52	2 5	1 44	0 54	25
6	0 13	1 14	1 53	2 5	1 43	0 52	24
7	0 15	1 16	1 54	2 4	1 41	0 50	23
8	0 17	1 17	1 55	2 4	1 40	0 48	22
9	0 19	1 18	1 56	2 4	1 39	0 46	21
10	0 21	1 19	1 57	2 4	1 37	0 44	20
11	0 23	1 21	1 58	2 3	1 36	0 42	19
12	0 25	1 22	1 58	2 3	1 34	0 40	18
13	0 28	1 24	1 59	2 3	1 33	0 37	17
14	0 30	1 26	2 0	2 2	1 31	0 35	16
15	0 32	1 27	2 0	2 2	1 30	0 33	15
16	0 34	1 28	2 1	2 1	1 28	0 31	14
17	0 36	1 30	2 1	2 1	1 27	0 29	13
18	0 38	1 31	2 2	2 0	1 25	0 27	12
19	0 40	1 34	2 2	2 0	1 24	0 24	11
20	0 42	1 35	2 3	1 59	1 23	0 22	10
21	0 44	1 36	2 3	1 59	1 21	0 20	9
22	0 46	1 37	2 4	1 58	1 19	0 18	8
23	0 48	1 39	2 4	1 57	1 17	0 16	7
24	0 50	1 40	2 4	1 56	1 15	0 13	6
25	0 52	1 41	2 4	1 55	1 13	0 11	5
26	0 54	1 43	2 5	1 54	1 11	0 9	4
27	0 56	1 44	2 5	1 53	1 9	0 7	3
28	0 58	1 45	2 5	1 52	1 8	0 5	2
29	1 0	1 46	2 5	1 51	1 6	0 3	1
30	1 2	1 47	2 5	1 50	1 4	0 0	0
	Signs 11	10	9	8	7	6	Deg.

ADD.

TABLE XXI. PART VII.—*Equation of the Sun's centre, or the difference between his mean and true place.*

Argument, Sun's mean anomaly.

SUBTRACT.

	0 Signs	1 Sign	2 Signs	3 Signs	4 Signs	5 Signs	
Deg.	° ' "	° ' "	° ' "	° ' "	° ' "	° ' "	
0	0 0 0	0 56 47	1 39 6	1 55 37	1 41 12	0 58 53	30
1	0 1 59	0 58 30	1 40 7	1 55 39	1 40 12	0 57 7	29
2	0 3 57	1 0 12	1 41 6	1 55 38	1 39 10	0 55 19	28
3	0 5 56	1 1 53	1 42 3	1 55 36	1 38 6	0 53 30	27
4	0 7 54	1 3 33	1 42 59	1 55 31	1 37 0	0 51 40	26
5	0 9 52	1 5 12	1 43 52	1 55 24	1 35 52	0 49 49	25
6	0 11 50	1 6 50	1 44 44	1 55 15	1 34 43	0 47 57	24
7	0 13 48	1 8 27	1 45 34	1 55 3	1 33 32	0 46 5	23
8	0 15 46	1 10 2	1 46 22	1 54 50	1 32 19	0 44 11	22
9	0 17 43	1 11 36	1 47 8	1 54 35	1 31 4	0 42 16	21
10	0 19 40	1 13 9	1 47 53	1 54 17	1 29 47	0 40 21	20
11	0 21 37	1 14 41	1 48 35	1 53 57	1 28 29	0 38 25	19
12	0 23 33	1 16 11	1 49 15	1 53 36	1 27 9	0 36 28	18
13	0 25 29	1 17 40	1 49 54	1 53 12	1 25 48	0 34 30	17
14	0 27 25	1 19 8	1 50 30	1 52 46	1 24 25	0 32 32	16
15	0 29 20	1 20 34	1 51 5	1 52 18	1 23 0	0 30 33	15
16	0 31 15	1 21 59	1 51 37	1 51 48	1 21 34	0 28 33	14
17	0 33 9	1 23 22	1 52 8	1 51 15	1 20 6	0 26 33	13
18	0 35 2	1 24 44	1 52 36	1 50 41	1 18 36	0 24 33	12
19	0 36 55	1 26 5	1 53 3	1 50 5	1 17 5	0 22 32	11
20	0 38 47	1 27 24	1 53 27	1 49 26	1 15 33	0 20 30	10
21	0 40 39	1 28 41	1 53 50	1 48 46	1 13 59	0 18 28	9
22	0 42 30	1 29 57	1 54 10	1 48 3	1 12 24	0 16 26	8
23	0 44 20	1 31 11	1 54 28	1 47 19	1 10 47	0 14 24	7
24	0 46 9	1 32 25	1 54 44	1 46 32	1 9 9	0 12 21	6
25	0 47 57	1 33 35	1 54 58	1 45 44	1 7 29	0 10 18	5
26	0 49 45	1 34 45	1 55 10	1 44 53	1 5 49	0 8 14	4
27	0 51 32	1 35 53	1 55 20	1 44 1	1 4 7	0 6 11	3
28	0 53 18	1 36 59	1 55 28	1 43 7	1 2 24	0 4 7	2
29	0 55 3	1 38 3	1 55 34	1 42 10	1 0 39	0 2 4	1
30	0 56 47	1 39 6	1 55 37	1 41 12	0 58 53	0 0 0	0
	Signs 11	10	9	8	7	6	Deg.

ADD.

TABLE XXI. Part VIII.—*Equation of Time.*

Argument, Sun's true place.

Sun faster than the clock in

	♈ — ♎ —	♉ — ♍ —	♊ — ♐ —	i Qr. iii Qr.
Deg.	m. s.	m. s.	m. s.	
0	0 0	8 23	8 45	30
1	0 20	8 33	8 34	29
2	0 40	8 43	8 24	28
3	1 0	8 52	8 12	27
4	1 19	9 1	8 0	26
5	1 39	9 9	7 47	25
6	1 58	9 16	7 34	24
7	2 18	9 23	7 20	23
8	2 37	9 29	7 5	22
9	2 56	9 35	6 50	21
10	3 15	9 39	6 34	20
11	3 34	9 43	6 18	19
12	3 52	9 47	6 1	18
13	4 10	9 49	5 44	17
14	4 28	9 51	5 26	16
15	4 46	9 53	5 8	15
16	5 3	9 53	4 50	14
17	5 20	9 53	4 31	13
18	5 37	9 52	4 11	12
19	5 53	9 50	3 51	11
20	6 9	9 48	3 31	10
21	6 25	9 45	3 11	9
22	6 40	9 41	2 51	8
23	6 54	9 37	2 30	7
24	7 8	9 31	2 9	6
25	7 22	9 25	1 48	5
26	7 35	9 19	1 26	4
27	7 48	9 11	1 5	3
28	8 0	9 3	0 43	2
29	8 12	8 54	0 22	1
30	8 23	8 45	0 0	0
Deg.	♏ + ♓ +	♌ + ♒ +	♋ + ♑ +	ii Qr. iv Qr.

Sun slower than the clock in

Note by the Editor, (Dr. Brewster).—"The Editor has computed the following Table anew, upon the supposition that the obliquity of the ecliptic is 23° 27′ 54″. When the obliquity of the ecliptic increases or diminishes, the equation of time will also increase or diminish, but by a quantity so very small that it amounts, at a maximum, to about *a second and a half* in the course of two centuries. The signs + and − indicate that this part of the equation of time is to be added to or subtracted from the apparent time. The numbers in this Table are the differences between the true longitude of the Sun, and his true right ascension, converted into time, at the rate of 15° per hour."

TABLE XXI. Part IX.—*Equation of Time.*

Argument, Sun's mean anomaly.

Sun faster than the clock if his anomaly be

	o Signs	i —	ii —	iii —	iv —	v —	
Deg.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	
0	0 0	3 47	6 36	7 42	6 44	3 55	30
1	0 8	3 54	6 40	7 42	6 40	3 48	29
2	0 16	4 0	6 40	7 42	6 36	3 41	28
3	0 24	4 7	6 44	7 42	6 32	3 34	27
4	0 32	4 14	6 47	7 41	6 27	3 26	26
5	0 39	4 20	6 51	7 41	6 23	3 19	25
6	0 47	4 27	6 55	7 40	6 18	3 12	24
7	0 55	4 33	6 58	7 39	6 13	3 4	23
8	1 3	4 40	7 1	7 38	6 9	2 56	22
9	1 11	4 46	7 5	7 37	6 4	2 49	21
10	1 19	4 52	7 8	7 36	5 58	2 43	20
11	1 26	4 58	7 11	7 35	5 53	2 33	19
12	1 34	5 4	7 14	7 34	5 48	2 26	18
13	1 42	5 10	7 16	7 32	5 43	2 18	17
14	1 49	5 16	7 19	7 30	5 37	2 10	16
15	1 57	5 22	7 21	7 28	5 31	2 2	15
16	2 5	5 27	7 23	7 26	5 26	1 54	14
17	2 12	5 33	7 26	7 24	5 20	1 46	13
18	2 20	5 38	7 28	7 22	5 14	1 38	12
19	2 27	5 44	7 30	7 20	5 8	1 30	11
20	2 35	5 49	7 31	7 17	5 2	1 22	10
21	2 42	5 54	7 33	7 14	4 55	1 14	9
22	2 50	5 59	7 34	7 11	4 49	1 6	8
23	2 57	6 4	7 36	7 8	4 43	0 58	7
24	3 4	6 9	7 37	7 5	4 36	0 49	6
25	3 12	6 14	7 38	7 2	4 30	0 41	5
26	3 19	6 19	7 39	6 59	4 23	0 33	4
27	3 26	6 23	7 40	6 55	4 16	0 25	3
28	3 33	6 27	7 41	6 52	4 9	0 17	2
29	3 40	6 32	7 41	6 48	4 2	0 8	1
30	3 47	6 36	7 42	6 44	3 55	0 0	0
	xi Signs	x +	ix +	viii +	vii +	vi +	Deg.

Sun slower than the clock, if his anomaly be

Note by the Editor, (Dr. Brewster).—"The following Table, which is nothing more than the equation of the Sun's orbit, or the difference between his mean and true place converted into time, has been computed anew from the accurate Solar Tables of M. de Lambre, and adapted to the year 1802. But as the equation of the solar orbit diminishes at the rate of 18″.8 in a century, this part of the equation of time will diminish at the rate of 1″.25 (18·25) in a century. There is also another variation in the equation of time, arising from the motion of the Sun's apogee, and amounting at a maximum to 14″.3 in a century, when the Sun is in the apogeal or perigeal points of his orbit. But for common these variations may be safely neglected."

TABLE XXII.—Part I.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 mean or actual Lunations.

Period i. B. C. 4004 to B. C. 3700. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period i, 3 760.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab. v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 29	May 28	Jun. 27	July 26	Aug. 25	Sep. 23	Oct. 23	Nov. 21	Dec. 21	Jan. 19	Feb. 18	Mar. 19	..	Feb. 18	Mar. 19
ii	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	..	.. 7	. 8
*iii	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26
iv	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
*v	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	Apr. 4	.. 4	.. 5
vi	May 4	Jun. 2	July 2	.. 31	.. 30	.. 28	.. 28	.. 26	.. 26	.. 24	.. 23	.. 24	..	.. 23	.. 24
vii	Apr. 23	May 22	Jun. 21	.. 20	.. 19	.. 17	.. 17	.. 15	.. 15	.. 13	.. 12	.. 13	..	.. 12	.. 13
*viii	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	Apr. 1	.. 1	.. 2
ix	May 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 25	.. 23	.. 23	.. 21	.. 20	.. 21	..	.. 20	.. 21
x	Apr. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 14	.. 12	.. 12	.. 10	.. 9	.. 10	..	.. 9	.. 10
*xi	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 29	Jan. 29	Feb. 28
xii	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 22	.. 20	.. 20	Jan. 18	Feb. 17	Mar. 18	..	Feb. 17	Mar. 18
*xiii	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	Apr. 6	.. 6	.. 7
xiv	May 6	Jun. 4	July 4	Aug. 2	Sep. 1	.. 30	.. 30	.. 28	.. 28	.. 26	.. 25	.. 26	..	.. 25	.. 26
xv	Apr. 25	May 24	Jun. 23	July 22	Aug. 21	.. 19	.. 19	.. 17	.. 17	.. 15	.. 14	.. 15	..	.. 14	.. 15
*xvi	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	Apr. 3	.. 3	.. 4
xvii	May 3	Jun. 1	July 1	.. 30	.. 29	.. 27	.. 27	.. 25	.. 25	.. 23	.. 22	. 23	..	.. 22	.. 23
xviii	Apr. 22	May 21	Jun. 20	.. 19	.. 18	.. 16	.. 16	.. 14	.. 14	.. 12	.. 11	.. 12	..	.. 11	.. 12
*xix	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar. 31	Jan. 31	.. 1

TABLE XXII.—Part II.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period ii. B. C. 3700 to B. C. 3396. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period ii, 7 520.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamus iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 28	May 27	Jun. 26	July 25	Aug. 24	Sep. 22	Oct. 22	Nov. 20	Dec. 20	Jan. 18	Feb. 17	Mar. 18	..	Feb. 17	Mar. 18
ii	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	..	.. 6	.. 7
*iii	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Jan. 26	Feb. 25
iv	.. 25	.. 24	.. 23	.. 22	.. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	..	Feb. 14	Mar. 15
*v	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	Apr. 3	.. 3	.. 4
vi	May 3	Jun. 1	July 1	.. 30	.. 29	.. 27	.. 27	.. 25	.. 25	.. 23	.. 22	.. 23	..	.. 22	.. 23
vii	Apr. 22	May 21	Jun. 20	.. 19	.. 18	.. 16	.. 16	.. 14	.. 14	.. 12	.. 11	.. 12	..	.. 11	.. 12
*viii	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar. 31	Jan. 31	.. 1
ix	.. 30	.. 29	.. 28	.. 27	.. 26	.. 24	.. 24	.. 22	.. 22	.. 20	Feb. 19	.. 20	..	Feb. 19	.. 20
x	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 9	..	.. 8	.. 9
*xi	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Jan. 28	Feb. 27
xii	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	..	Feb. 16	Mar. 17
*xiii	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	Apr. 5	.. 5	.. 6
xiv	May 5	Jun. 3	July 3	Aug. 1	.. 31	.. 29	.. 29	.. 27	.. 27	.. 25	.. 24	.. 25	..	.. 24	.. 25
xv	Apr. 24	May 23	Jun. 22	July 21	.. 20	.. 18	.. 18	.. 16	.. 16	.. 14	.. 13	.. 14	..	.. 13	.. 14
*xvi	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	Apr. 2	.. 2	.. 3
xvii	May 2	.. 31	.. 30	.. 29	.. 28	.. 26	.. 26	.. 24	.. 24	.. 22	.. 21	.. 22	..	.. 21	.. 22
xviii	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	..	.. 10	.. 11
*xix	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Jan. 30	Feb. 29

TABLE XXII.—Part III.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period iii. B. C. 3396 to B. C. 3092. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period iii, 11 280.

													Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 27	May 26	June 25	July 24	Aug. 23	Sep. 21	Oct. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	..	Feb. 16	Mar. 17
ii	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	..	.. 5	.. 6
*iii	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Jan. 25	Feb. 24
iv	.. 24	.. 23	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
*v	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	. 3	Apr. 2	.. 2	.. 3
vi	May 2	.. 31	.. 30	.. 29	.. 28	.. 26	.. 26	.. 24	.. 24	.. 22	.. 21	.. 22	..	.. 21	.. 22
vii	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	..	.. 10	.. 11
*viii	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Jan. 30	Feb. 29
ix	.. 29	.. 28	.. 27	.. 26	.. 25	.. 23	.. 23	.. 21	.. 21	Jan. 19	Feb. 18	Mar. 19	..	Feb. 18	Mar. 19
x	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	.	.. 7	.. 8
*xi	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26
xii	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
*xiii	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	Apr. 4	.. 4	.. 5
xiv	May 4	June 2	July 2	.. 31	.. 30	.. 28	.. 28	.. 26	.. 26	.. 24	.. 23	.. 24	..	.. 23	.. 24
xv	Apr. 23	May 22	June 21	.. 20	.. 19	.. 17	.. 17	.. 15	.. 15	.. 13	.. 12	.. 13	..	.. 12	.. 13
*xvi	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	Apr. 1	.. 1	.. 2
xvii	May 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 25	.. 23	.. 23	.. 21	.. 20	.. 21	..	.. 20	.. 21
xviii	Apr. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 14	.. 12	.. 12	.. 10	.. 9	.. 10	..	.. 9	.. 10
*xix	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 29	Jan. 29	Feb. 28

TABLE XXII.—Part IV.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period iv. B. C. 3092 to B. C. 2788. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period iv, 15 040.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 26	May 25	June 24	July 23	Aug. 22	Sep. 20	Oct. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
ii	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	..	.. 4	.. 5
*iii	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23
iv	.. 23	.. 22	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	..	Feb. 12	Mar. 13
*v	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	Apr. 1	.. 1	.. 2
vi	May 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 25	.. 23	.. 23	.. 21	.. 20	.. 21	..	.. 20	.. 21
vii	Apr. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 14	.. 12	.. 12	.. 10	.. 9	.. 10	..	.. 9	.. 10
*viii	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 29	Jan. 29	Feb. 28
ix	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 22	.. 20	.. 20	Jan. 18	Feb. 17	Mar. 18	..	Feb. 17	Mar. 18
x	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	..	.. 6	.. 7
*xi	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Jan. 26	Feb. 25
xii	.. 25	.. 24	.. 23	.. 22	.. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	..	Feb. 14	Mar. 15
*xiii	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	Apr. 3	.. 3	.. 4
xiv	May 3	June 1	July 1	.. 30	.. 29	.. 27	.. 27	.. 25	.. 25	.. 23	.. 22	.. 23	..	.. 22	.. 23
xv	Apr. 22	May 21	June 20	.. 19	.. 18	.. 16	.. 16	.. 14	.. 14	.. 12	.. 11	.. 12	.	.. 11	.. 12
*xvi	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar. 31	Jan. 31	.. 1
xvii	.. 30	.. 29	.. 28	.. 27	.. 26	.. 24	.. 24	.. 22	.. 22	.. 20	Feb. 19	.. 20	..	Feb. 19	.. 20
xviii	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 9	..	.. 8	.. 9
*xix	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Jan. 28	Feb. 27

TABLE XXII.—Part V.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period v. B. C. 2788 to B. C. 2484. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period v, 18 800.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 25	May 24	June 23	July 22	Aug. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	..	Feb. 14	Mar. 15
ii	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	..	.. 3	.. 4
*iii	.. 3	.. 2	.. 1	June 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Jan. 23	Feb. 22
iv	.. 22	.. 21	.. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	..	Feb. 11	Mar. 12
*v	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar. 31	Jan. 31	.. 1
vi	.. 30	.. 29	.. 28	.. 27	.. 26	.. 24	.. 24	.. 22	.. 22	.. 20	Feb. 19	.. 20	..	Feb. 19	.. 20
vii	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 9	..	.. 8	.. 9
*viii	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Jan. 28	Feb. 27
ix	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	..	Feb. 16	Mar. 17
x	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	..	.. 5	.. 6
*xi	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 25	Mar. 25	Jan. 25	Feb. 24
xii	.. 24	. 23	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
*xiii	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	Apr. 2	.. 2	.. 3
xiv	May 2	.. 31	.. 30	.. 29	.. 28	.. 26	.. 26	.. 24	.. 24	.. 22	.. 21	.. 22	..	.. 21	.. 22
xv	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	..	.. 10	.. 11
*xvi	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Jan. 30	Feb. 29
xvii	.. 29	.. 28	. 27	.. 26	.. 25	.. 23	.. 23	.. 21	.. 21	Jan. 19	Feb. 18	Mar. 19	..	Feb. 18	Mar. 19
xviii	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	..	.. 7	.. 8
*xix	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26

TABLE XXII.—Part VI.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period vi B. C. 2484 to B. C. 2180. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period vi, 22 560.

													Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamus iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 24	May 23	Jun. 22	July 21	Aug. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
ii	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	..	.. 2	.. 3
*iii	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21
iv	.. 21	.. 20	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
*v	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Jan. 30	Feb. 29
vi	.. 29	.. 28	.. 27	.. 26	.. 25	.. 23	.. 23	.. 21	.. 21	Jan. 19	Feb. 18	Mar. 19	..	Feb. 18	Mar. 19
vii	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	..	.. 7	.. 8
*viii	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26
ix	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
x	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	..	.. 4	.. 5
*xi	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23
xii	.. 23	.. 22	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	..	Feb. 12	Mar. 13
*xiii	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	Apr. 1	.. 1	.. 2
xiv	May 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 25	.. 23	.. 23	.. 21	.. 20	.. 21	..	.. 20	.. 21
xv	Apr. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 14	.. 12	.. 12	.. 10	.. 9	.. 10	..	.. 9	.. 10
*xvi	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 29	Jan. 29	Feb. 28
xvii	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 22	.. 20	.. 20	Jan. 18	Feb. 17	Mar. 18	..	Feb. 17	Mar. 18
xviii	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	..	.. 6	.. 7
*xix	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Jan. 26	Feb. 25

TABLE XXII.—Part VII.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period vii B. C. 2180 to B. C. 1876. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period vii, 26 320.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr.23	May 22	Jun. 21	July 20	Aug.19	Sep. 17	Oct. 17	Nov.15	Dec. 15	Jan. 13	Feb. 12	Mar.13	..	Feb. 12	Mar.13
ii	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	..	.. 1	.. 2
*iii	.. 1	Apr.30	May 30	Jun. 28	July 28	Aug.26	Sep. 25	Oct. 24	Nov.23	Dec. 22	Jan. 21	Feb. 19	Mar.21	Jan. 21	Feb. 20
iv	.. 20	May 19	Jun. 18	July 17	Aug.16	Sep. 14	Oct. 14	Nov.12	Dec. 12	Jan. 10	Feb. 9	Mar.10	..	Feb. 9	Mar.10
*v	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar.29	Jan. 29	Feb. 28
vi	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 22	.. 20	.. 20	Jan. 18	Feb. 17	Mar.18	..	Feb. 17	Mar.18
vii	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	..	.. 6	.. 7
*viii	.. 6	.. 5	.. 4	.. 3	.. 2	Aug.31	Sep. 30	Oct. 29	Nov.28	Dec. 27	Jan. 26	Feb. 24	Mar.26	Jan. 26	Feb. 25
ix	.. 25	.. 24	.. 23	. 22	.. 21	Sep. 19	Oct. 19	Nov.17	Dec. 17	Jan. 15	Feb. 14	Mar.15	..	Feb. 14	Mar.15
x	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	..	.. 3	.. 4
*xi	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug.28	Sep. 27	Oct. 26	Nov.25	Dec. 24	Jan. 23	Feb. 21	Mar.23	Jan. 23	Feb. 22
xii	.. 22	.. 21	.. 20	July 19	Aug.18	Sep. 16	Oct. 16	Nov.14	Dec. 14	Jan. 12	Feb. 11	Mar.12	..	Feb. 11	Mar.12
*xiii	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar.31	Jan. 31	.. 1
xiv	.. 30	.. 29	.. 28	.. 27	.. 26	.. 24	.. 24	.. 22	.. 22	.. 20	Feb. 19	.. 20	..	Feb. 19	.. 20
xv	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 9	..	.. 8	.. 9
*xvi	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov.30	Dec. 29	Jan. 28	Feb. 26	Mar.28	Jan. 28	Feb. 27
xvii	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 21	Nov.19	Dec. 19	Jan. 17	Feb. 16	Mar.17	..	Feb. 16	Mar.17
xviii	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	..	.. 5	.. 6
*xix	.. 5	.. 4	.. 3	.. 2	.. 1	Aug.30	Sep. 29	Oct. 28	Nov.27	Dec. 26	Jan. 25	Feb. 23	Mar.25	Jan. 25	Feb. 24

TABLE XXII.—Part VIII.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period viii B.C. 1876 to B.C. 1572. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period viii, 30 080.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 22	May 21	Jun. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	..	Feb. 11	Mar. 12
ii	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	..	Jan. 31	.. 1
*iii	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19
iv	Apr. 19	May 18	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
*v	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Jan. 28	Feb. 27
vi	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	..	Feb. 16	Mar. 17
vii	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	..	.. 5	.. 6
*viii	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Jan. 25	Feb. 24
ix	.. 24	.. 23	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
x	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	..	.. 2	.. 3
*xi	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21
xii	.. 21	.. 20	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
*xiii	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Jan. 30	Feb. 29
xiv	.. 29	.. 28	.. 27	.. 26	.. 25	.. 23	.. 23	.. 21	.. 21	Jan. 19	Feb. 18	Mar. 19	..	Feb. 18	Mar. 19
xv	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	..	.. 7	.. 8
*xvi	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26
xvii	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
xviii	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	..	.. 4	.. 5
*xix	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23

TABLE XXII.—Part IX.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period ix B. C. 1572 to B. C. 1268. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period ix, 33 840.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 21	May 20	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
ii	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	..	Jan. 30	Feb. 29
*iii	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	Mar. 19	.. 19	.. 18
iv	Apr. 18	May 17	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
*v	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26
vi	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
vii	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	..	.. 4	.. 5
*viii	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23
ix	.. 23	.. 22	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	..	Feb. 12	Mar. 13
x	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	..	.. 1	.. 2
*xi	.. 1	Apr. 30	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Jan. 21	Feb. 20
xii	.. 20	May 19	Jun. 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	..	Feb. 9	Mar. 10
*xiii	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 29	Jan. 29	Feb. 28
xiv	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 22	.. 20	.. 20	Jan. 18	Feb. 17	Mar. 18	..	Feb. 17	Mar. 18
xv	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	..	.. 6	.. 7
*xvi	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Jan. 26	Feb. 25
xvii	.. 25	.. 24	.. 23	.. 22	.. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	..	Feb. 14	Mar. 15
xviii	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	... 6	.. 4	.. 3	.. 4	..	.. 3	.. 4
*xix	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Jan. 23	Feb. 22

TABLE XXII.—Part X.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period x B. C. 1268 to B. C. 964. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period x, 37 600.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 20	May 19	Jun. 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	..	Feb. 9	Mar. 10
ii	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	..	Jan. 29	Feb. 28
*iii	Mar. 29	Apr. 27	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17
iv	Apr. 17	May 16	Jun. 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
*v	.. 6	.. 5	.. 4	. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Jan. 26	Feb. 25
vi	.. 25	.. 24	.. 23	.. 22	.. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	..	Feb. 14	Mar. 15
vii	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	..	.. 3	.. 4
*viii	.. 3	. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Jan. 23	Feb. 22
ix	.. 22	.. 21	.. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	..	Feb. 11	Mar. 12
x	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	..	Jan. 31	.. 1
*xi	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19
xii	Apr. 19	May 18	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
*xiii	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Jan. 28	Feb. 27
xiv	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	..	Feb. 16	Mar. 17
xv	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	..	.. 5	.. 6
*xvi	.. 5	.. 4	. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Jan. 25	Feb. 24
xvii	.. 24	.. 23	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
xviii	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	..	.. 2	.. 3
*xix	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21

TABLE XXII.—Part XI.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xi B. C. 964 to B. C. 660. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xi, 41 360.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marches-van viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 19	May 18	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
ii	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	..	Jan. 28	Feb. 27
*iii	Mar. 28	Apr. 26	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	Mar. 17	.. 17	.. 16
iv	Apr. 16	May 15	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	..	Feb. 5	Mar. 6
*v	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Jan. 25	Feb. 24
vi	.. 24	.. 23	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
vii	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	..	.. 2	.. 3
*viii	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21
ix	.. 21	.. 20	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
x	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	..	Jan. 30	Feb. 29
*xi	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	Feb. 17	Mar. 19	.. 19	.. 18
xii	Apr. 18	May 17	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
*xiii	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Jan. 27	Feb. 26
xiv	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..	Feb. 15	Mar. 16
xv	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	..	.. 4	.. 5
*xvi	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23
xvii	.. 23	.. 22	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	..	Feb. 12	Mar. 13
xviii	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	..	.. 1	.. 2
*xix	.. 1	Apr. 30	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Jan. 21	Feb. 20

TABLE XXII.—Part XII.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xii B. C. 660 to B. C. 356. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xii, 45 120.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 18	May 17	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
ii	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	..	Jan. 27	Feb. 26
*iii	Mar. 27	Apr. 25	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	Mar. 16	.. 16	.. 15
iv	Apr. 15	May 14	Jun. 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	..	Feb. 4	Mar. 5
*v	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23
vi	.. 23	.. 22	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	..	Feb. 12	Mar. 13
vii	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	..	.. 1	.. 2
*viii	.. 1	Apr. 30	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Jan. 21	Feb. 20
ix	.. 20	May 19	Jun. 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	..	Feb. 9	Mar. 10
x	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	..	Jan. 29	Feb. 28
*xi	Mar. 29	Apr. 27	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17
xii	Apr. 17	May 16	Jun. 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
*xiii	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Jan. 26	Feb. 25
xiv	.. 25	.. 24	.. 23	.. 22	.. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	..	Feb. 14	Mar. 15
xv	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	..	.. 3	.. 4
*xvi	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Jan. 23	Feb. 22
xvii	.. 22	.. 21	.. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	..	Feb. 11	Mar. 12
xviii	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	..	Jan. 31	.. 1
*xix	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19

TABLE XXII.—PART XIII.

FASTI CATHOLICI. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xiii B. C. 356 to B. C. 52. Horary epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xiii, 48 880.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marches-van viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 17	May 16	Jun. 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
ii	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	..	Jan. 26	Feb. 25
*iii	Mar. 26	Apr. 24	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	Mar. 15	.. 15	.. 14
iv	Apr. 14	May 13	Jun. 12	July 11	Aug. 10	Sep. 8	Oct. 8	Nov. 6	Dec. 6	Jan. 4	Feb. 3	Mar. 4	..	Feb. 3	Mar. 4
*v	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Jan. 23	Feb. 22
vi	.. 22	.. 21	.. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	..	Feb. 11	Mar. 12
vii	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	..	Jan. 31	.. 1
*viii	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19
ix	Apr. 19	May 18	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
x	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	..	Jan. 28	Feb. 27
*xi	Mar. 28	Apr. 26	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	Mar. 17	.. 17	.. 16
xii	Apr. 16	May 15	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	..	Feb. 5	Mar. 6
*xiii	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Jan. 25	Feb. 24
xiv	.. 24	.. 23	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	..	Feb. 13	Mar. 14
xv	.. 13	. 12	.. 11	.. 10	.. 9	.. 7	. 7	.. 5	.. 5	.. 3	.. 2	.. 3	..	.. 2	.. 3
*xvi	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21
xvii	.. 21	.. 20	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
xviii	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	..	Jan. 30	Feb. 29
*xix	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	Mar. 19	.. 19	.. 18

TABLE XXII.—Part XIV.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xiv B. C. 52 to A. D. 253. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xiv, 52 640.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 16	May 15	June 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	..	Feb. 5	Mar. 6
ii	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	..	Jan. 25	Feb. 24
*iii	Mar. 25	Apr. 23	May 23	June 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	Mar. 14	.. 14	.. 13
iv	Apr. 13	May 12	June 11	July 10	Aug. 9	Sep. 7	Oct. 7	Nov. 5	Dec. 5	Jan. 3	Feb. 2	Mar. 3	..	Feb. 2	Mar. 3
*v	.. 2	.. 1	May 31	June 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21
vi	.. 21	.. 20	June 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
vii	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	..	Jan. 30	Feb. 29
*viii	Mar. 30	Apr. 28	May 28	June 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	Mar. 19	.. 19	.. 18
ix	Apr. 18	May 17	June 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
x	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	..	Jan. 27	Feb. 26
*xi	Mar. 27	Apr. 25	May 25	June 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	Mar. 16	.. 16	.. 15
xii	Apr. 15	May 14	June 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	..	Feb. 4	Mar. 5
*xiii	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Jan. 24	Feb. 23
xiv	.. 23	.. 22	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	..	Feb. 12	Mar. 13
xv	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	..	.. 1	.. 2
*xvi	.. 1	Apr. 30	May 30	June 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Jan. 21	Feb. 20
xvii	.. 20	May 19	June 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	..	Feb. 9	Mar. 10
xviii	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	..	Jan. 29	Feb. 28
*xix	Mar. 29	Apr. 27	May 27	June 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17

TABLE XXII.—PART XV.

FASTI CATHOLICI. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xv A.D. 253 to A.D. 557. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xv, 56 400.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 15	May 14	June 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	..	Feb. 4	Mar. 5
ii	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	..	Jan. 24	Feb. 23
*iii	Mar. 24	Apr. 22	May 22	June 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	Mar. 13	.. 13	.. 12
iv	Apr. 12	May 11	June 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	..	Feb. 1	Mar. 2
*v	.. 1	Apr. 30	May 30	June 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Jan. 21	Feb. 20
vi	.. 20	May 19	June 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	..	Feb. 9	Mar. 10
vii	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	..	Jan. 29	Feb. 28
*viii	Mar. 29	Apr. 27	May 27	June 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17
ix	Apr. 17	May 16	June 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
x	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	..	Jan. 26	Feb. 25
*xi	Mar. 26	Apr. 24	May 24	June 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	Mar. 15	.. 15	.. 14
xii	Apr. 14	May 13	June 12	July 11	Aug. 10	Sep. 8	Oct. 8	Nov. 6	Dec. 6	Jan. 4	Feb. 3	Mar. 4	..	Feb. 3	Mar. 4
*xiii	.. 3	.. 2	.. 1	June 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Jan. 23	Feb. 22
xiv	.. 22	.. 21	.. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	..	Feb. 11	Mar. 12
xv	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	..	Jan. 31	.. 1
*xvi	Mar. 31	Apr. 29	May 29	June 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19
xvii	Apr. 19	May 18	June 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
xviii	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	..	Jan. 28	Feb. 27
*xix	Mar. 28	Apr. 26	May 26	June 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	Mar. 17	.. 17	.. 16

TABLE XXII.—Part XVI.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xvi A. D. 557 to A. D. 861. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xvi, 60160.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamus iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 14	May 13	Jun. 12	July 11	Aug. 10	Sep. 8	Oct. 8	Nov. 6	Dec. 6	Jan. 4	Feb. 3	Mar. 4	..	Feb. 3	Mar. 4
ii	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	..	Jan. 23	Feb. 22
*iii	Mar. 23	Apr. 21	May 21	.. 19	.. 19	.. 17	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	Mar. 12	.. 12	.. 11
iv	Apr. 11	May 10	Jun. 9	July 8	Aug. 7	Sep. 5	Oct. 5	Nov. 3	Dec. 3	Jan. 1	.. 31	Mar. 1	..	.. 31	Mar. 1
*v	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19
vi	Apr. 19	May 18	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
vii	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	..	Jan. 28	Feb. 27
*viii	Mar. 28	Apr. 26	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	Mar. 17	.. 17	.. 16
ix	Apr. 16	May 15	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	..	Feb. 5	Mar. 6
x	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	..	Jan. 25	Feb. 24
*xi	Mar. 25	Apr. 23	May 23	Jun. 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	Mar. 14	.. 14	.. 13
xii	Apr. 13	May 12	Jun. 11	July 10	Aug. 9	Sep. 7	Oct. 7	Nov. 5	Dec. 5	Jan. 3	Feb. 2	Mar. 3	..	Feb. 2	Mar. 3
*xiii	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Jan. 22	Feb. 21
xiv	.. 21	.. 20	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	..	Feb. 10	Mar. 11
xv	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	..	Jan. 30	Feb. 29
*xvi	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	Mar. 19	.. 19	.. 18
xvii	Apr. 18	May 17	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
xviii	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	..	Jan. 27	Feb. 26
*xix	Mar. 27	Apr. 25	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	Mar. 16	.. 16	.. 15

TABLE XXII.—Part XVII.

Fasti Catholici. Lunar Cycle, Type I. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xvii A. D. 861 to A. D. 1165. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xvii, 63 920.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 13	May 12	Jun. 11	July 10	Aug. 9	Sep. 7	Oct. 7	Nov. 5	Dec. 5	Jan. 3	Feb. 2	Mar. 3	..	Feb. 2	Mar. 3
ii	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	..	Jan. 22	Feb. 21
*iii	Mar. 22	Apr. 20	.. 20	.. 18	.. 18	.. 16	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	Mar. 11	.. 11	.. 10
iv	Apr. 10	May 9	Jun. 8	July 7	Aug. 6	Sep. 4	Oct. 4	Nov. 2	Dec. 2	.. 31	.. 30	.. 28	..	.. 30	.. 29
*v	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	Mar. 19	.. 19	.. 18
vi	Apr. 18	May 17	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
vii	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	..	Jan. 27	Feb. 26
*viii	Mar. 27	Apr. 25	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	Mar. 16	.. 16	.. 15
ix	Apr. 15	May 14	Jun. 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	..	Feb. 4	Mar. 5
x	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	..	Jan. 24	Feb. 23
*xi	Mar. 24	Apr. 22	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	Mar. 13	.. 13	.. 12
xii	Apr. 12	May 11	Jun. 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	..	Feb. 1	Mar. 2
*xiii	.. 1	Apr. 30	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Jan. 21	Feb. 20
xiv	.. 20	May 19	Jun. 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	..	Feb. 9	Mar. 10
xv	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	..	Jan. 29	Feb. 28
*xvi	Mar. 29	Apr. 27	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17
xvii	Apr. 17	May 16	Jun. 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
xviii	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	..	Jan. 26	Feb. 25
*xix	Mar. 26	Apr. 24	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	Mar. 15	.. 15	.. 14

TABLE XXII.—Part XVIII.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xviii A.D. 1165 to A.D. 1469. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xviii, 67 680.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab. v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 12	May 11	Jun. 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	..	Feb. 1	Mar. 2
ii	.. 1	Apr. 30	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	..	Jan. 21	Feb. 20
*iii	Mar. 21	.. 19	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	Mar. 10	.. 10	.. 9
iv	Apr. 9	May 8	Jun. 7	July 6	Aug. 5	Sep. 3	Oct. 3	Nov. 1	Dec. 1	.. 30	.. 29	.. 27	..	.. 29	.. 28
*v	Mar. 29	Apr. 27	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17
vi	Apr. 17	May 16	Jun. 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
vii	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	..	Jan. 26	Feb. 25
*viii	Mar. 26	Apr. 24	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	Mar. 15	.. 15	.. 14
ix	Apr. 14	May 13	Jun. 12	July 11	Aug. 10	Sep. 8	Oct. 8	Nov. 6	Dec. 6	Jan. 4	Feb. 3	Mar. 4	..	Feb. 3	Mar. 4
x	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	..	Jan. 23	Feb. 22
*xi	Mar. 23	Apr. 21	May 21	.. 19	.. 19	.. 17	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	Mar. 12	.. 12	.. 11
xii	Apr. 11	May 10	Jun. 9	July 8	Aug. 7	Sep. 5	Oct. 5	Nov. 3	Dec. 3	Jan. 1	.. 31	Mar. 1	..	.. 31	Mar. 1
*xiii	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	Mar. 20	.. 20	Feb. 19
xiv	Apr. 19	May 18	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	..	Feb. 8	Mar. 9
xv	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	..	Jan. 28	Feb. 27
*xvi	Mar. 28	Apr. 26	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	Mar. 17	.. 17	.. 16
xvii	Apr. 16	May 15	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	..	Feb. 5	Mar. 6
xviii	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	..	Jan. 25	Feb. 24
*xix	Mar. 25	Apr. 23	May 23	Jun. 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	Mar. 14	.. 14	.. 13

TABLE XXII.—Part XIX.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xix A. D. 1469 to A. D. 1773. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xix, 71 440.

														Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamuz iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marches-van viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 11	May 10	Jun. 9	July 8	Aug. 7	Sep. 5	Oct. 5	Nov. 3	Dec. 3	Jan. 1	Jan. 31	Mar. 1	..	Jan. 31	Mar. 1
ii	Mar. 31	Apr. 29	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	..	.. 20	Feb. 19
*iii	.. 20	.. 18	.. 18	.. 16	.. 16	.. 14	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	Mar. 9	.. 9	.. 8
iv	Apr. 8	May 7	Jun. 6	July 5	Aug. 4	Sep. 2	Oct. 2	.. 31	.. 30	.. 29	.. 28	.. 26	..	.. 28	.. 27
*v	Mar. 28	Apr. 26	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	Mar. 17	.. 17	.. 16
vi	Apr. 16	May 15	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	..	Feb. 5	Mar. 6
vii	.. 5	.. 4	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	..	Jan. 25	Feb. 24
*viii	Mar. 25	Apr. 23	May 23	Jun. 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	Mar. 14	.. 14	.. 13
ix	Apr. 13	May 12	Jun. 11	July 10	Aug. 9	Sep. 7	Oct. 7	Nov. 5	Dec. 5	Jan. 3	Feb. 2	Mar. 3	..	Feb. 2	Mar. 3
x	.. 2	.. 1	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	..	Jan. 22	Feb. 21
*xi	Mar. 22	Apr. 20	.. 20	.. 18	.. 18	.. 16	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	Mar. 11	.. 11	.. 10
xii	Apr. 10	May 9	Jun. 8	July 7	Aug. 6	Sep. 4	Oct. 4	Nov. 2	Dec. 2	.. 31	.. 30	.. 28	..	.. 30	.. 29
*xiii	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	Mar. 19	.. 19	.. 18
xiv	Apr. 18	May 17	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	..	Feb. 7	Mar. 8
xv	.. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	..	Jan. 27	Feb. 26
*xvi	Mar. 27	Apr. 25	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	Mar. 16	.. 16	.. 15
xvii	Apr. 15	May 14	Jun. 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	..	Feb. 4	Mar. 5
xviii	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	..	Jan. 24	Feb. 23
*xix	Mar. 24	Apr. 22	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	Mar. 13	.. 13	.. 12

TABLE XXII.—Part XX.

Fasti Catholici. Lunar Cycle, Type i. In Hipparchean Periods of 304 mean Julian years, xvi Metonic Cycles, 3760 Lunations.

Period xx A. D. 1773 to A. D. 2077. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Sum of Lunations at the end of Period xx, 75 200.

													Leap-year.	
Cycle.	Nisan i. 29.	Jar ii. 30.	Sivan iii. 29.	Thamus iv. 30.	Ab v. 29.	Elul vi. 30.	Tisri vii. 29.	Marchesvan viii. 30.	Chisleu ix. 29.	Tebeth x. 30.	Sebat xi. 29.	Adar xii. 30. 29.	Veadar xiii. 30. 29.	Sebat xi. 30.	Adar xii. 30. 29.
i	Apr. 10	May 9	June 8	July 7	Aug. 6	Sep. 4	Oct. 4	Nov. 2	Dec. 2	Dec. 31	Jan. 30	Feb. 28	..	Jan. 30	Feb. 29
ii	Mar. 30	Apr. 28	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	..	.. 19	.. 18
*iii	.. 19	.. 17	.. 17	.. 15	.. 15	.. 13	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	Mar. 8	.. 8	.. 7
iv	Apr. 7	May 6	June 5	July 4	Aug. 3	Sep. 1	Oct. 1	.. 30	.. 29	.. 28	.. 27	.. 25	..	.. 27	.. 26
*v	Mar. 27	Apr. 25	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	Mar. 16	.. 16	.. 15
vi	Apr. 15	May 14	June 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	..	Feb. 4	Mar. 5
vii	.. 4	.. 3	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	..	Jan. 24	Feb. 23
*viii	Mar. 24	Apr. 22	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	Mar. 13	.. 13	.. 12
ix	Apr. 12	May 11	June 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	..	Feb. 1	Mar. 2
x	.. 1	Apr. 30	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	..	Jan. 21	Feb. 20
*xi	Mar. 21	.. 19	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	Mar. 10	.. 10	.. 9
xii	Apr. 9	May 8	June 7	July 6	Aug. 5	Sep. 3	Oct. 3	Nov. 1	Dec. 1	.. 30	.. 29	.. 27	..	.. 29	.. 28
*xiii	Mar. 29	Apr. 27	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	Mar. 18	.. 18	.. 17
xiv	Apr. 17	May 16	June 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	..	Feb. 6	Mar. 7
xv	.. 6	.. 5	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	..	Jan. 26	Feb. 25
*xvi	Mar. 26	Apr. 24	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	Mar. 15	.. 15	.. 14
xvii	Apr. 14	May 13	June 12	July 11	Aug. 10	Sep. 8	Oct. 8	Nov. 6	Dec. 6	Jan. 4	Feb. 3	Mar. 4	..	Feb. 3	Mar. 4
xviii	.. 3	.. 2	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	..	Jan. 23	Feb. 22
*xix	Mar. 23	Apr. 21	May 21	.. 19	.. 19	.. 17	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	Mar. 12	.. 12	.. 11

TABLE XXIII.—Part I.

Lunar Cycle of the Fasti, Type ii. In the Hipparchean Period of 304 mean Julian years, xvi Metonic Cycles, xix Hekkaidekaëteric Cycles, 3760 Lunations.

Period i, Cycle i A. M. 1–305 B. C. 4004–3700. Horary Epoch midnight, mean time. Meridian of Jerusalem.

Year.	Metonic Cycle. i.	Hekkaidekaëteric Cycle i.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
1	1	i	Apr. 29	May 28	Jun. 27	July 26	Aug. 25	Sep. 23	Oct. 23	Nov. 21	Dec. 21	Jan. 19	Feb. 18	Mar. 19	..
2	2	ii	.. 18	.. 17	.. 16	. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	..
*3	*3	*iii*	.. 7	. 6	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 26	Mar. 27
*4	4	iv	.. 26	.. 25	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	..
5	*5	*v	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	Apr. 4
6	6	vi	May 4	Jun. 2	July 2	.. 31	.. 30	.. 28	.. 28	.. 26	.. 26	.. 24	.. 23	.. 24	..
*7	7	vii*	Apr. 23	May 22	Jun. 21	.. 20	.. 19	.. 17	.. 17	.. 15	.. 15	.. 13	.. 12	.. 13	..
*8	*8	*viii	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	Apr. 1
9	9	ix	May 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 25	.. 23	.. 23	.. 21	. 20	.. 21	..
10	10	x	Apr. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 14	.. 12	.. 12	.. 10	.. 9	.. 10	..
*11	*11	*xi*	.. 9	.. 8	. 7	.. 6	.. 5	.. 3	. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 28	Mar. 29
*12	12	xii	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 22	.. 20	.. 20	Jan. 18	Feb. 17	Mar. 18	..
13	*13	*xiii	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 11	.. 9	.. 9	.. 7	.. 6	.. 7	Apr. 6
14	14	xiv	May 6	Jun. 4	July 4	Aug. 2	Sep. 1	.. 30	.. 30	.. 28	.. 28	.. 26	.. 25	.. 26	..
*15	15	xv	Apr. 25	May 24	Jun. 23	July 22	Aug. 21	.. 19	.. 19	.. 17	.. 17	.. 15	.. 14	.. 14	..
*16	*16	*xvi	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	Apr. 2

TABLE XXIII.—Part II.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle ii.

	Metonic Cycle	Hekkaidekaëteric Cycle													
Year.	i. ii.	ii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
17	17	i	May 2	May 31	Jun. 30	July 29	Aug. 28	Sep. 26	Oct. 26	Nov. 24	Dec. 24	Jan. 22	Feb. 21	Mar. 22	..
18	18	ii	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	..
*19	*19	*iii*	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 29	Mar. 30
*20	1	iv	.. 29	.. 28	.. 27	.. 26	.. 25	.. 23	.. 23	.. 21	.. 21	Jan. 19	Feb. 18	Mar. 19	..
21	2	*v	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	Apr. 7
22	*3	vi	May 7	Jun. 5	July 5	Aug. 3	Sep. 2	Oct. 1	.. 31	.. 29	.. 29	.. 27	.. 26	.. 27	..
*23	4	vii*	Apr. 26	May 25	Jun. 24	July 23	Aug. 22	Sep. 20	.. 20	.. 18	.. 18	.. 16	.. 15	.. 16	.
*24	*5	*viii	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	Apr. 4
25	6	ix	May 4	Jun. 2	July 2	.. 31	.. 30	.. 28	.. 28	.. 26	.. 26	.. 24	.. 23	.. 24	..
26	7	x	Apr. 23	May 22	Jun. 21	.. 20	.. 19	.. 17	.. 17	.. 15	.. 15	.. 13	.. 12	.. 13	..
*27	*8	*xi*	.. 12	.. 11	.. 10	.. 9	. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 2	Apr. 1
*28	9	xii	May 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 25	.. 23	.. 23	.. 21	.. 20	.. 21	..
29	10	*xiii	Apr. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 14	.. 12	.. 12	.. 10	.. 9	.. 10	Apr. 9
30	*11	xiv	May 9	Jun. 7	July 7	Aug. 5	Sep. 4	Oct. 3	Nov. 2	Dec. 1	.. 31	. 29	.. 28	.. 29	..
*31	12	xv	Apr. 28	May 27	Jun. 26	July 25	Aug. 24	Sep. 22	Oct. 22	Nov. 20	.. 20	.. 18	.. 17	.. 17	..
*32	*13	*xvi	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	Apr. 5

TABLE XXIII.—PART III.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle iii.

Year.	Metonic Cycle. ii. iii.	Hekkaidekaëteric Cycle. iii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
33	14	i	May 5	Jun. 3	July 3	Aug. 1	Aug. 31	Sep. 29	Oct. 29	Nov. 27	Dec. 27	Jan. 25	Feb. 24	Mar. 25	..
34	15	ii	Apr. 24	May 23	Jun. 22	July 21	.. 20	.. 18	.. 18	.. 16	.. 16	.. 14	.. 13	.. 14	..
*35	*16	*iii*	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	Apr. 2
*36	17	iv	May 2	.. 31	.. 30	.. 29	.. 28	.. 26	.. 26	.. 24	.. 24	.. 22	.. 21	.. 22	..
37	18	*v	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	Apr. 10
38	*19	vi	May 10	Jun. 8	July 8	Aug. 6	Sep. 5	Oct. 4	Nov. 3	Dec. 2	Jan. 1	.. 30	Mar. 1	.. 30	..
*39	1	vii*	Apr. 29	May 28	Jun. 27	July 26	Aug. 25	Sep. 23	Oct. 23	Nov. 21	Dec. 21	.. 19	Feb. 18	.. 19	..
*40	2	*viii	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	Apr. 7
41	*3	ix	May 7	Jun. 5	July 5	Aug. 3	Sep. 2	Oct. 1	.. 31	.. 29	.. 29	.. 27	.. 26	.. 27	..
42	4	x	Apr. 26	May 25	Jun. 24	July 23	Aug. 22	Sep. 20	.. 20	.. 18	.. 18	.. 16	.. 15	.. 16	..
*43	*5	*xi*	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 5	Apr. 4
*44	6	xii	May 4	Jun. 2	July 2	.. 31	.. 30	.. 28	.. 28	.. 26	.. 26	.. 24	.. 23	.. 24	..
45	7	*xiii	Apr. 23	May 22	Jun. 21	.. 20	.. 19	.. 17	.. 17	.. 15	.. 15	.. 13	.. 12	.. 13	Apr. 12
46	*8	xiv	May 12	Jun. 10	July 10	Aug. 8	Sep. 7	Oct. 6	Nov. 5	Dec. 4	Jan. 3	Feb. 1	Mar. 3	Apr. 1	..
*47	9	xv	.. 1	May 30	Jun. 29	July 28	Aug. 27	Sep. 25	Oct. 25	Nov. 23	Dec. 23	Jan. 21	Feb. 20	Mar. 20	..
*48	10	*xvi	Apr. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 9	Apr. 8

TABLE XXIII.—PART IV.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle iv.

Year.	Metonic Cycle iii. iv.	Hekkaidekaëteric Cycle iv.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
49	*11	i	May 8	Jun. 6	July 6	Aug. 4	Sep. 3	Oct. 2	Nov. 1	Nov. 30	Dec. 30	Jan. 28	Feb. 27	Mar. 28	.
50	12	ii	Apr. 27	May 26	Jun. 25	July 24	Aug. 23	Sep. 21	Oct. 21	.. 19	.. 19	.. 17	.. 16	.. 17	..
*51	*13	*iii*	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	. 5	.. 6	Apr. 5
*52	14	iv	May 5	Jun. 3	July 3	Aug. 1	.. 31	.. 29	.. 29	.. 27	.. 27	.. 25	.. 24	.. 25	..
53	15	*v	Apr. 24	May 23	Jun. 22	July 21	.. 20	.. 18	.. 18	.. 16	.. 16	.. 14	.. 13	.. 14	Apr. 13
54	*16	vi	May 13	Jun. 11	July 11	Aug. 9	Sep. 8	Oct. 7	Nov. 6	Dec. 5	Jan. 4	Feb. 2	Mar. 4	Apr. 2	..
*55	17	vii*	.. 2	May 31	Jun. 30	July 29	Aug. 28	Sep. 26	Oct. 26	Nov. 24	Dec. 24	Jan. 22	Feb. 21	Mar. 22	..
*56	18	*viii	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	Apr. 10
57	*19	ix	May 10	Jun. 8	July 8	Aug. 6	Sep. 5	Oct. 4	Nov. 3	Dec. 2	Jan. 1	.. 30	Mar. 1	.. 30	..
58	1	x	Apr. 29	May 28	Jun. 27	July 26	Aug. 25	Sep. 23	Oct. 23	Nov. 21	Dec. 21	.. 19	Feb. 18	.. 19	..
*59	2	*xi*	. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 8	Apr. 7
*60	*3	xii	May 7	Jun. 5	July 5	Aug. 3	Sep. 2	Oct. 1	.. 31	.. 29	.. 29	.. 27	.. 26	.. 27	..
61	4	*xiii	Apr. 26	May 25	Jun. 24	July 23	Aug. 22	Sep. 20	.. 20	.. 18	.. 18	.. 16	.. 15	.. 16	Apr. 15
62	*5	xiv	May 15	Jun. 13	July 13	Aug. 11	Sep. 10	Oct. 9	Nov. 8	Dec. 7	Jan. 6	Feb. 4	Mar. 6	Apr. 4	..
*63	6	xv	.. 4	.. 2	.. 2	July 31	Aug. 30	Sep. 28	Oct. 28	Nov. 26	Dec. 26	Jan. 24	Feb. 23	Mar. 23	..
*64	7	*xvi	Apr. 22	May 21	Jun. 20	.. 19	.. 18	.. 16	.. 16	... 14	.. 14	.. 12	.. 11	.. 12	Apr. 11

TABLE XXIII.—Part V.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle v.

Year.	Metonic Cycle iv. v.	Hekkaidekaëteric Cycle v.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
65	*8	i	May 11	Jun. 9	July 9	Aug. 7	Sep. 6	Oct. 5	Nov. 4	Dec. 3	Jan. 2	Jan. 31	Mar. 2	Mar. 31	..
66	9	ii	Apr. 30	May 29	Jun. 28	July 27	Aug. 26	Sep. 24	Oct. 24	Nov. 22	Dec. 22	.. 20	Feb. 19	.. 20	..
*67	10	*iii*	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 9	Apr. 8
*68	*11	iv	May 8	Jun. 6	July 6	Aug. 4	Sep. 3	Oct. 2	Nov. 1	.. 30	.. 30	.. 28	.. 27	.. 28	..
69	12	*v	Apr. 27	May 26	Jun. 25	July 24	Aug. 23	Sep. 21	Oct. 21	.. 19	.. 19	.. 17	.. 16	.. 17	Apr. 16
70	*13	vi	May 16	Jun. 14	July 14	Aug. 12	Sep. 11	Oct. 10	Nov. 9	Dec. 8	Jan. 7	Feb. 5	Mar. 7	Apr. 5	..
*71	14	vii*	.. 5	.. 3	.. 3	.. 1	Aug. 31	Sep. 29	Oct. 29	Nov. 27	Dec. 27	Jan. 25	Feb. 24	Mar. 25	..
*72	15	*viii	Apr. 24	May 23	Jun. 22	July 21	.. 20	.. 18	.. 18	.. 16	.. 16	.. 14	.. 13	.. 14	Apr. 13
73	*16	ix	May 13	Jun. 11	July 11	Aug. 9	Sep. 8	Oct. 7	Nov. 6	Dec. 5	Jan. 4	Feb. 2	Mar. 4	Apr. 2	..
74	17	x	.. 2	May 31	Jun. 30	July 29	Aug. 28	Sep. 26	Oct. 26	Nov. 24	Dec. 24	Jan. 22	Feb. 21	Mar. 22	..
*75	18	*xi*	Apr. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 11	Apr. 10
*76	*19	xii	May 10	Jun. 8	July 8	Aug. 6	Sep. 5	Oct. 4	Nov. 3	Dec. 2	Jan. 1	.. 30	Mar. 1	.. 30	..
77	1	*xiii	Apr. 29	May 28	Jun. 27	July 26	Aug. 25	Sep. 23	Oct. 23	Nov. 21	Dec. 21	.. 19	Feb. 18	.. 19	Apr. 18
78	2	xiv	May 18	Jun. 16	July 16	Aug. 14	Sep. 13	Oct. 12	Nov. 11	Dec. 10	Jan. 9	Feb. 7	Mar. 9	Apr. 7	..
*79	*3	xv	.. 7	.. 5	.. 5	.. 3	.. 2	.. 1	Oct. 31	Nov. 29	Dec. 29	Jan. 27	Feb. 26	Mar. 26	..
*80	4	*xvi	Apr. 25	May 24	Jun. 23	July 22	Aug. 21	Sep. 19	.. 19	.. 17	.. 17	.. 15	.. 14	.. 15	Apr. 14

TABLE XXIII.—Part VI.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle vi.

	Metonic Cycle	Hekkaidekaëteric Cycle												
Year.	v. vi.	vi.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
81	*5	i	May 14	Jun. 12	July 12	Aug. 10	Sep. 9	Oct. 8	Nov. 7	Dec. 6	Jan. 5	Feb. 3	Mar. 5	Apr. 3	..
82	6	ii	.. 3	.. 1	.. 1	July 30	Aug. 29	Sep. 27	Oct. 27	Nov. 25	Dec. 25	Jan. 23	Feb. 22	Mar. 23	..
*83	7	*iii*	Apr. 22	May 21	Jun. 20	.. 19	.. 18	.. 16	.. 16	.. 14	.. 14	.. 12	.. 11	.. 12	Apr. 11
*84	*8	iv	May 11	Jun. 9	July 9	Aug. 7	Sep. 6	Oct. 5	Nov. 4	Dec. 3	Jan. 2	.. 31	Mar. 2	.. 31	..
85	9	*v	Apr. 30	May 29	Jun. 28	July 27	Aug. 26	Sep. 24	Oct. 24	Nov. 22	Dec. 22	.. 20	Feb. 19	.. 20	Apr. 19
86	10	vi	May 19	Jun. 17	July 17	Aug. 15	Sep. 14	Oct. 13	Nov. 12	Dec. 11	Jan. 10	Feb. 8	Mar. 10	Apr. 8	..
*87	*11	vii*	.. 8	.. 6	.. 6	.. 4	.. 3	.. 2	.. 1	Nov. 30	Dec. 30	Jan. 28	Feb. 27	Mar. 28	..
*88	12	*viii	Apr. 27	May 26	Jun. 25	July 24	Aug. 23	Sep. 21	Oct. 21	.. 19	.. 19	.. 17	.. 16	.. 17	Apr. 16
89	*13	ix	May 16	Jun. 14	July 14	Aug. 12	Sep. 11	Oct. 10	Nov. 9	Dec. 8	Jan. 7	Feb. 5	Mar. 7	Apr. 5	..
90	14	x	.. 5	.. 3	.. 3	.. 1	Aug. 31	Sep. 29	Oct. 29	Nov. 27	Dec. 27	Jan. 25	Feb. 24	Mar. 25	..
*91	15	*xi*	Apr. 24	May 23	Jun. 22	July 21	.. 20	.. 18	.. 18	.. 16	.. 16	.. 14	.. 13	.. 14	Apr. 13
*92	*16	xii	May 13	Jun. 11	July 11	Aug. 9	Sep. 8	Oct. 7	Nov. 6	Dec. 5	Jan. 4	Feb. 2	Mar. 4	Apr. 2	..
93	17	*xiii	.. 2	May 31	Jun. 30	July 29	Aug. 28	Sep. 26	Oct. 26	Nov. 24	Dec. 24	Jan. 22	Feb. 21	Mar. 22	Apr. 21
94	18	xiv	.. 21	Jun. 19	July 19	Aug. 17	Sep. 16	Oct. 15	Nov. 14	Dec. 13	Jan. 12	Feb. 10	Mar. 12	Apr. 10	..
*95	*19	xv	.. 10	.. 8	.. 8	.. 6	.. 5	.. 4	.. 3	.. 2	.. 1	Jan. 30	Feb. 29	Mar. 29	..
*96	1	*xvi	Apr. 28	May 27	Jun. 26	July 25	Aug. 24	Sep. 22	Oct. 22	Nov. 20	Dec. 20	.. 18	.. 17	.. 18	Apr. 17

TABLE XXIII.—Part VII.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle vii.

Year.	Metonic Cycle vi.	Hekkaidekaëteric Cycle vii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
97	2	i	May 17	Jun. 15	July 15	Aug. 13	Sep. 12	Oct. 11	Nov. 10	Dec. 9	Jan. 8	Feb. 6	Mar. 8	Apr. 6	..
98	*3	ii	.. 6	.. 4	.. 4	.. 2	.. 1	Sep. 30	Oct. 30	Nov. 28	Dec. 28	Jan. 26	Feb. 25	Mar. 26	..
*99	4	*iii*	Apr. 25	May 24	Jun. 23	July 22	Aug. 21	.. 19	.. 19	.. 17	.. 17	.. 15	.. 14	.. 15	Apr. 14
*100	*5	iv	May 14	Jun. 12	July 12	Aug. 10	Sep. 9	Oct. 8	Nov. 7	Dec. 6	Jan. 5	Feb. 3	Mar. 5	Apr. 3	..
101	6	*v	.. 3	.. 1	.. 1	July 30	Aug. 29	Sep. 27	Oct. 27	Nov. 25	Dec. 25	Jan. 23	Feb. 22	Mar. 23	Apr. 22
102	7	vi	.. 22	.. 20	.. 20	Aug. 18	Sep. 17	Oct. 16	Nov. 15	Dec. 14	Jan. 13	Feb. 11	Mar. 13	Apr. 11	..
*103	*8	vii *	.. 11	.. 9	.. 9	.. 7	.. 6	.. 5	.. 4	.. 3	.. 2	Jan. 31	.. 1	Mar. 31	..
*104	9	*viii	Apr. 30	May 29	Jun. 28	July 27	Aug. 26	Sep. 24	Oct. 24	Nov. 22	Dec. 22	.. 20	Feb. 19	.. 20	Apr. 19
105	10	ix	May 19	Jun. 17	July 17	Aug. 15	Sep. 14	Oct. 13	Nov. 12	Dec. 11	Jan. 10	Feb. 8	Mar. 10	Apr. 8	..
106	*11	x	.. 8	.. 6	.. 6	.. 4	.. 3	.. 2	.. 1	Nov. 30	Dec. 30	Jan. 28	Feb. 27	Mar. 28	..
*107	12	*xi*	Apr. 27	May 26	Jun. 25	July 24	Aug. 23	Sep. 21	Oct. 21	.. 19	.. 19	.. 17	.. 16	.. 17	Apr. 16
*108	*13	xii	May 16	Jun. 14	July 14	Aug. 12	Sep. 11	Oct. 10	Nov. 9	Dec. 8	Jan. 7	Feb. 5	Mar. 7	Apr. 5	..
109	14	*xiii	.. 5	.. 3	.. 3	.. 1	Aug. 31	Sep. 29	Oct. 29	Nov. 27	Dec. 27	Jan. 25	Feb. 24	Mar. 25	Apr. 24
110	15	xiv	.. 24	.. 22	.. 22	.. 20	Sep. 19	Oct. 18	Nov. 17	Dec. 16	Jan. 15	Feb. 13	Mar. 15	Apr. 13	..
*111	*16	xv	.. 13	.. 11	.. 11	.. 9	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 3	.. 1	..
*112	17	*xvi	.. 1	May 30	Jun. 29	July 28	Aug. 27	Sep. 25	Oct. 25	Nov. 23	Dec. 23	Jan. 21	Feb. 20	Mar. 21	Apr. 20

TABLE XXIII.—Part VIII.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle viii.

Year.	Metonic Cycle vi. vii.	Hekkaidekaëteric Cycle viii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
113	18	i	May 20	Jun. 18	July 18	Aug. 16	Sep. 15	Oct. 14	Nov. 13	Dec. 12	Jan. 11	Feb. 9	Mar. 11	Apr. 9	..
114	*19	ii	.. 9	.. 7	.. 7	.. 5	4	.. 3	.. 2	.. 1	Dec. 31	Jan. 29	Feb. 28	Mar. 29	..
*115	1	*iii*	Apr. 28	May 27	Jun. 26	July 25	Aug. 24	Sep. 22	Oct. 22	Nov. 20	.. 20	.. 18	.. 17	.. 18	Apr. 17
*116	2	iv	May 17	Jun. 15	July 15	Aug. 13	Sep. 12	Oct. 11	Nov. 10	Dec. 9	Jan. 8	Feb. 6	Mar. 8	Apr. 6	..
117	*3	*v	.. 6	.. 4	.. 4	.. 2	.. 1	Sep. 30	Oct. 30	Nov. 28	Dec. 28	Jan. 26	Feb. 25	Mar. 26	Apr. 25
118	4	vi	.. 25	.. 23	.. 23	.. 21	.. 20	Oct. 19	Nov. 18	Dec. 17	Jan. 16	Feb. 14	Mar. 16	Apr. 14	..
*119	*5	vii*	.. 14	.. 12	.. 12	.. 10	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 4	.. 3	..
*120	6	*viii	.. 3	.. 1	.. 1	July 30	Aug. 29	Sep. 27	Oct. 27	Nov. 25	Dec. 25	Jan. 23	Feb. 22	Mar. 23	Apr. 22
121	7	ix	.. 22	.. 20	.. 20	Aug. 18	Sep. 17	Oct. 16	Nov. 15	Dec. 14	Jan. 13	Feb. 11	Mar. 13	Apr. 11	..
122	*8	x	.. 11	.. 9	.. 9	.. 7	.. 6	.. 5	.. 4	.. 3	.. 2	Jan. 31	.. 2	Mar. 31	..
*123	9	*xi*	Apr. 30	May 29	Jun. 28	July 27	Aug. 26	Sep. 24	Oct. 24	Nov. 22	Dec. 22	.. 20	Feb. 19	Mar. 20	Apr. 19
*124	10	xii	May 19	Jun. 17	July 17	Aug. 15	Sep. 14	Oct. 13	Nov. 12	Dec. 11	Jan. 10	Feb. 8	Mar. 10	Apr. 8	..
125	*11	*xiii	.. 8	. 6	.. 6	.. 4	.. 3	.. 2	.. 1	Nov. 30	Dec. 30	Jan. 28	Feb. 27	Mar. 28	Apr. 27
126	12	xiv	.. 27	.. 25	.. 25	.. 23	.. 22	.. 21	.. 20	Dec. 19	Jan. 18	Feb. 16	Mar. 18	Apr. 16	..
*127	*13	xv	.. 16	.. 14	. 14	.. 12	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 6	Apr. 4	..
*128	14	*xvi	.. 4	.. 2	.. 2	July 31	Aug. 30	Sep. 28	Oct. 28	Nov. 26	Dec. 26	Jan. 24	Feb. 23	Mar. 24	Apr. 23

TABLE XXIII.—Part IX.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle ix.

	Metonic Cycle	Hekkaidekaëteric Cycle													
Year.	vii. viii.	ix.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
129	15	i	May 23	Jun. 21	July 21	Aug. 19	Sep. 18	Oct. 17	Nov. 16	Dec. 15	Jan. 14	Feb. 12	Mar. 14	Apr. 12	..
130	*16	ii	.. 12	.. 10	.. 10	.. 8	. 7	.. 6	.. 5	.. 4	.. 3	.. 1	.. 3	.. 1	..
*131	17	*iii*	.. 1	May 30	Jun. 29	July 28	Aug. 27	Sep. 25	Oct. 25	Nov. 23	Dec. 23	Jan. 21	Feb. 20	Mar. 21	Apr. 20
*132	18	iv	.. 20	Jun. 18	July 18	Aug. 16	Sep. 15	Oct. 14	Nov. 13	Dec. 12	Jan. 11	Feb. 9	Mar. 11	Apr. 9	..
133	*19	*v	.. 9	.. 7	.. 7	.. 5	.. 4	.. 3	.. 2	.. 1	Dec. 31	Jan. 29	Feb. 28	Mar. 29	Apr. 28
134	1	vi	.. 28	.. 26	.. 26	.. 24	.. 23	.. 22	.. 21	.. 20	Jan. 19	Feb. 17	Mar. 19	Apr. 17	..
*135	2	vii*	.. 17	.. 15	.. 15	.. 13	. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 7	.. 6	..
*136	*3	*viii	.. 6	.. 4	.. 4	.. 2	.. 1	Sep. 30	Oct. 30	Nov. 28	Dec. 28	Jan. 26	Feb. 25	Mar. 26	Apr. 25
137	4	ix	.. 25	.. 23	.. 23	.. 21	.. 20	Oct. 19	Nov. 18	Dec. 17	Jan. 16	Feb. 14	Mar. 16	Apr. 14	..
138	*5	x	.. 14	.. 12	.. 12	.. 10	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 5	.. 3	..
*139	6	*xi*	.. 3	.. 1	.. 1	July 30	Aug. 29	Sep. 27	Oct. 27	Nov. 25	Dec. 25	Jan. 23	Feb. 22	Mar. 23	Apr. 22
*140	7	xii	.. 22	.. 20	.. 20	Aug. 18	Sep. 17	Oct. 16	Nov. 15	Dec. 14	Jan. 13	Feb. 11	Mar. 13	Apr. 11	..
141	*8	*xiii	.. 11	.. 9	.. 9	.. 7	.. 6	.. 5	.. 4	.. 3	.. 2	Jan. 31	.. 2	Mar. 31	Apr. 30
142	9	xiv	.. 30	.. 28	.. 28	.. 26	.. 25	.. 24	.. 23	.. 22	.. 21	Feb. 19	.. 21	Apr. 19	..
*143	10	xv*	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 9	.. 8	..
*144	*11	*xvi	.. 8	.. 6	.. 6	.. 4	.. 3	.. 2	.. 1	Nov. 30	Dec. 30	Jan. 28	Feb. 27	Mar. 28	Apr. 27

TABLE XXIII.—Part X.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle x.

Year.	Metonic Cycle viii. ix.	Hekkaidekaëteric Cycle x.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
145	12	i	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	Dec. 19	Jan. 18	Feb. 16	Mar. 18	Apr. 16	..
146	*13	ii	.. 16	.. 14	.. 14	.. 12	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 7	.. 5	..
*147	14	*iii*	.. 5	.. 3	.. 3	.. 1	Aug. 31	Sep. 29	Oct. 29	Nov. 27	Dec. 27	Jan. 25	Feb. 24	Mar. 25	Apr. 24
*148	15	iv	.. 24	.. 22	.. 22	.. 20	Sep. 19	Oct. 18	Nov. 17	Dec. 16	Jan. 15	Feb. 13	Mar. 15	Apr. 13	..
149	*16	*v	.. 13	.. 11	.. 11	.. 9	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 4	.. 2	May 2
150	17	vi	Jun. 1	.. 30	.. 30	.. 28	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 23	.. 21	..
*151	18	vii*	May 21	.. 19	.. 19	.. 17	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 11	.. 10	..
*152	*19	*viii	.. 10	.. 8	.. 8	.. 6	.. 5	.. 4	.. 3	.. 2	.. 1	Jan. 30	.. 1	Mar. 30	Apr. 29
153	1	ix	.. 29	.. 27	.. 27	.. 25	.. 24	.. 23	.. 22	.. 21	.. 20	Feb. 18	.. 20	Apr. 18	..
154	2	x	.. 18	.. 16	.. 16	.. 14	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 9	.. 7	..
*155	*3	*xi*	.. 7	.. 5	.. 5	.. 3	.. 2	.. 1	Oct. 31	Nov. 29	Dec. 29	Jan. 27	Feb. 26	Mar. 27	Apr. 26
*156	4	xii	.. 26	.. 24	.. 24	.. 22	.. 21	.. 20	Nov. 19	Dec. 18	Jan. 17	Feb. 15	Mar. 17	Apr. 15	..
157	*5	*xiii	.. 15	.. 13	.. 13	.. 11	.. 10	.. 9	.. 8	.. 7	.. 6	.. 4	.. 6	.. 4	May 4
158	6	xiv	Jun. 3	July 2	Aug. 1	.. 30	.. 29	.. 28	.. 27	.. 26	.. 25	.. 23	.. 25	Apr. 23	..
*159	7	xv	May 23	Jun. 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 13	.. 11	..
*160	*8	*xvi	.. 11	.. 9	.. 9	.. 7	.. 6	.. 5	.. 4	.. 3	.. 2	Jan. 31	.. 2	Mar. 31	Apr. 30

TABLE XXIII.—Part XI.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xi.

Year.	Metonic Cycle ix. x.	Hekkaidekaëteric Cycle xi.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
161	9	i	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	Apr. 19	..
162	10	ii	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 10	.. 8	..
*163	*11	*iii*	.. 8	.. 6	.. 6	.. 4	.. 3	.. 2	.. 1	Nov. 30	Dec. 30	Jan. 28	Feb. 27	Mar. 28	Apr. 27
*164	12	iv	.. 27	.. 25	.. 25	.. 23	.. 22	. 21	.. 20	Dec. 19	Jan. 18	Feb. 16	Mar. 18	Apr. 16	..
165	*13	*v	.. 16	.. 14	.. 14	.. 12	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 7	.. 5	May 5
166	14	vi	Jun. 4	July 3	Aug. 2	.. 31	.. 30	.. 29	.. 28	. 27	.. 26	.. 24	.. 26	.. 24	..
*167	15	vii*	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 14	.. 13	..
*168	*16	*viii	.. 13	.. 11	.. 11	.. 9	.. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 4	.. 2	May 2
169	17	ix	Jun. 1	.. 30	.. 30	.. 28	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 23	.. 21	..
170	18	x	May 21	.. 19	.. 19	.. 17	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 12	.. 10	..
*171	*19	*xi*	.. 10	.. 8	.. 8	.. 6	.. 5	.. 4	.. 3	.. 2	.. 1	Jan. 30	Feb. 29	Mar. 30	Apr. 29
*172	1	xii	.. 29	.. 27	.. 27	.. 25	.. 24	.. 23	.. 22	.. 21	.. 20	Feb. 18	Mar. 20	Apr. 18	..
173	2	*xiii	.. 18	.. 16	.. 16	.. 14	.. 13	.. 12	.. 11	.. 10	.. 9	.. 7	.. 9	.. 7	May 7
174	*3	xiv	Jun. 6	July 5	Aug. 4	Sep. 2	Oct. 2	.. 31	.. 30	.. 29	.. 28	.. 26	.. 28	.. 26	..
*175	4	xv	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 16	.. 14	..
*176	*5	*xvi	.. 14	.. 12	.. 12	.. 10	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 5	.. 3	May 3

TABLE XXIII.—PART XII.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xii.

Year.	Metonic Cycle x. xi.	Hekkaidekaëteric Cycle xii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
177	6	i	Jun. 2	July 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Apr. 22	..
178	7	ii	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 13	.. 11	..
*179	*8	*iii*	.. 11	.. 9	.. 9	.. 7	.. 6	.. 5	.. 4	.. 3	.. 2	Jan. 31	.. 1	Mar. 31	Apr. 30
*180	9	iv	.. 30	.. 28	.. 28	.. 26	.. 25	.. 24	.. 23	.. 22	.. 21	Feb. 19	.. 21	Apr. 19	..
181	10	*v	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 10	.. 8	May 8
182	*11	vi	Jun. 7	July 6	Aug. 5	Sep. 3	Oct. 3	Nov. 1	Dec. 1	.. 30	.. 29	.. 27	.. 29	.. 27	..
*183	12	vii*	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	.. 17	.. 16	..
*184	*13	*viii	.. 16	.. 14	.. 14	.. 12	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 7	.. 5	May 5
185	14	ix	Jun. 4	July 3	Aug. 2	.. 31	.. 30	.. 29	.. 28	.. 27	.. 26	.. 24	.. 26	.. 24	..
186	15	x	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 15	.. 13	..
*187	*16	*xi*	.. 13	.. 11	.. 11	.. 9	. 8	.. 7	.. 6	.. 5	.. 4	.. 2	.. 3	.. 2	May 2
*188	17	xii	Jun. 1	.. 30	.. 30	.. 28	.. 27	.. 26	.. 25	.. 24	.. 23	.. 21	.. 23	.. 21	..
189	18	*xiii	May 21	.. 19	.. 19	.. 17	.. 16	.. 15	.. 14	.. 13	.. 12	.. 10	.. 12	.. 10	May 10
190	*19	xiv	Jun. 9	July 8	Aug. 7	Sep. 5	Oct. 5	Nov. 3	Dec. 3	Jan. 1	.. 31	Mar. 1	.. 31	.. 29	..
*191	1	xv	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	. 19	... 17	..
*192	2	*xvi	.. 17	.. 15	.. 15	.. 13	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 8	.. 6	May 6

TABLE XXIII.—Part XIII.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xiii.

Year.	Metonic Cycle xi.	Hekkaidekaëteric Cycle xiii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
193	*3	i	Jun. 5	July 4	Aug. 3	Sep. 1	Oct. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Apr. 25	..
194	4	ii	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 16	.. 14	..
*195	*5	*iii*	.. 14	.. 12	.. 12	.. 10	.. 9	.. 8	.. 7	.. 6	.. 5	.. 3	.. 4	.. 3	May 3
*196	6	iv	Jun. 2	July 1	.. 31	.. 29	.. 28	.. 27	.. 26	.. 25	.. 24	.. 22	.. 24	.. 22	..
197	7	*v	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 13	.. 11	May 11
198	*8	vi	Jun. 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	Apr. 1	.. 30	..
*199	9	vii*	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 20	.. 19	..
*200	10	*viii	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 10	.. 8	May 8
201	*11	ix	Jun. 7	July 6	Aug. 5	Sep. 3	Oct. 3	Nov. 1	Dec. 1	.. 30	.. 29	.. 27	.. 29	.. 27	..
202	12	x	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	.. 18	.. 16	..
*203	*13	*xi*	.. 16	.. 14	.. 14	.. 12	.. 11	.. 10	.. 9	.. 8	.. 7	.. 5	.. 6	.. 5	May 5
*204	14	xii	Jun. 4	July 3	Aug. 2	.. 31	.. 30	.. 29	.. 28	.. 27	.. 26	.. 24	.. 26	.. 24	..
205	15	*xiii	May 24	Jun. 22	July 22	.. 20	.. 19	.. 18	.. 17	.. 16	.. 15	.. 13	.. 15	.. 13	May 13
206	*16	xiv	Jun. 12	July 11	Aug. 10	Sep. 8	Oct. 8	Nov. 6	Dec. 6	Jan. 4	Feb. 3	Mar. 4	Apr. 3	May 2	..
*207	17	xv	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 22	Apr. 20	..
*208	18	*xvi	May 20	.. 18	.. 18	.. 16	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 11	.. 9	May 9

TABLE XXIII.—Part XIV.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xiv.

	Metonic Cycle	Hekkaidekaëteric Cycle												
Year.	xi.xii.	xiv.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
209	*19	i	Jun. 8	July 7	Aug. 6	Sep. 4	Oct. 4	Nov. 2	Dec. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Apr. 28	..
210	1	ii	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	.. 19	.. 17	..
*211	2	*iii*	.. 17	.. 15	.. 15	.. 13	.. 12	.. 11	.. 10	.. 9	.. 8	.. 6	.. 7	.. 6	May 6
*212	*3	iv	Jun. 5	July 4	Aug. 3	Sep. 1	Oct. 1	.. 30	.. 29	.. 28	.. 27	.. 25	.. 27	.. 25	..
213	4	*v	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 16	.. 14	May 14
214	*5	vi	Jun. 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	Apr. 4	May 3	..
*215	6	vii *	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 23	Apr. 22	..
*216	7	*viii	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 13	.. 11	May 11
217	*8	ix	Jun. 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	Apr. 1	.. 30	..
218	9	x	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	.. 19	..
*219	10	*xi*	.. 19	.. 17	.. 17	.. 15	.. 14	.. 13	.. 12	.. 11	.. 10	.. 8	.. 9	.. 8	May 8
*220	*11	xii	Jun. 7	July 6	Aug. 5	Sep. 3	Oct. 3	Nov. 1	Dec. 1	.. 30	.. 29	.. 27	.. 29	.. 27	..
221	12	*xiii	May 27	Jun. 25	July 25	Aug. 23	Sep. 22	Oct. 21	Nov. 20	.. 19	.. 18	.. 16	.. 18	.. 16	May 16
222	*13	xiv	Jun. 15	July 14	Aug. 13	Sep. 11	Oct. 11	Nov. 9	Dec. 9	Jan. 7	Feb. 6	Mar. 7	Apr. 6	May 5	..
*223	14	xv	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 25	Apr. 23	..
*224	15	*xvi	May 23	Jun. 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 14	.. 12	May 12

TABLE XXIII.—Part XV.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xv.

Year.	Metonic Cycle xii. xiii.	Hekkaidekaëteric Cycle xv.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
225	*16	i	Jun. 11	July 10	Aug. 9	Sep. 7	Oct. 7	Nov. 5	Dec. 5	Jan. 3	Feb. 2	Mar. 3	Apr. 2	May 1	..
226	17	ii	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Apr. 20	..
*227	18	*iii*	.. 20	.. 18	.. 18	. 16	.. 15	.. 14	.. 13	.. 12	.. 11	.. 9	.. 10	.. 9	May 9
*228	*19	iv	Jun. 8	July 7	Aug. 6	Sep. 4	Oct. 4	Nov. 2	Dec. 2	.. 31	.. 30	.. 28	.. 30	.. 28	..
229	1	*v	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	.. 19	.. 17	May 17
230	2	vi	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	Apr. 7	May 6	..
*231	*3	vii*	.. 5	.. 4	.. 3	. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 26	Apr. 25	..
*232	4	*viii	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 16	.. 14	May 14
233	*5	ix	Jun. 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	Apr. 4	May 3	..
234	6	x	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Apr. 22	..
*235	7	*xi*	May 22	Jun. 20	.. 20	.. 18	.. 17	.. 16	.. 15	.. 14	.. 13	.. 11	.. 12	.. 11	May 11
*236	*8	xii	Jun. 10	July 9	Aug. 8	Sep. 6	Oct. 6	Nov. 4	Dec. 4	Jan. 2	Feb. 1	Mar. 2	Apr. 1	.. 30	..
237	9	*xiii	May 30	Jun. 28	July 28	Aug. 26	Sep. 25	Oct. 24	Nov. 23	Dec. 22	Jan. 21	Feb. 19	Mar. 21	.. 19	May 19
238	10	xiv	Jun. 18	July 17	Aug. 16	Sep. 14	Oct. 14	Nov. 12	Dec. 12	Jan. 10	Feb. 9	Mar. 10	Apr. 9	May 8	..
*239	*11	xv	. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 28	Apr. 26	..
*240	12	*xvi	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	Oct. 20	Nov. 19	.. 18	.. 17	.. 15	.. 17	.. 15	May 15

TABLE XXIII.—PART XVI.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xvi.

Year.	Metonic Cycle xiii. xiv.	Hekkaidekaëteric Cycle xvi.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
241	*13	i	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	Apr. 5	May 4	..
242	14	ii	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Apr. 23	..
*243	15	*iii*	May 23	Jun. 21	July 21	.. 19	.. 18	.. 17	.. 16	.. 15	.. 14	.. 12	.. 13	.. 12	May 12
*244	*16	iv	Jun. 11	July 10	Aug. 9	Sep. 7	Oct. 7	Nov. 5	Dec. 5	Jan. 3	Feb. 2	Mar. 3	Apr. 2	May 1	..
245	17	*v	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Apr. 20	May 20
246	18	vi	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	Apr. 10	May 9	..
*247	*19	vii*	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 29	Apr. 28	..
*248	1	*viii	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	. 19	.. 17	.. 19	.. 17	May 17
249	2	ix	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	Apr. 7	May 6	..
250	*3	x	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Apr. 25	..
*251	4	*xi*	May 25	Jun. 23	July 23	Aug. 21	Sep. 20	.. 19	.. 18	.. 17	.. 16	.. 14	.. 15	.. 14	May 14
*252	*5	xii	Jun. 13	July 12	Aug. 11	Sep. 9	Oct. 9	Nov. 7	Dec. 7	Jan. 5	Feb. 4	Mar. 5	Apr. 4	May 3	..
253	6	*xiii	.. 2	.. 1	July 31	Aug. 29	Sep. 28	Oct. 27	Nov. 26	Dec. 25	Jan. 24	Feb. 22	Mar. 24	Apr. 22	May 22
254	7	xiv	.. 21	.. 20	Aug. 19	Sep. 17	Oct. 17	Nov. 15	Dec. 15	Jan. 13	Feb. 12	Mar. 13	Apr. 12	May 11	..
*255	*8	xv	.. 10	.. 9	.. 8	.. 6	.. 6	.. 4	.. 4	.. 2	.. 1	.. 1	Mar. 31	Apr. 29	..
*256	9	*xvi	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	Jan. 20	Feb. 18	.. 20	.. 18	May 18

TABLE XXIII.—Part VI.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xvii.

Year.	Metonic Cycle xiv. xv.	Hekkaidekaëteric Cycle xvii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
257	10	i	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	Apr. 8	May 7	..
258	*11	ii	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Apr. 26	..
*259	12	*iii*	May 26	Jun. 24	July 24	Aug. 22	Sep. 21	.. 20	.. 19	.. 18	.. 17	.. 15	.. 16	.. 15	May 15
*260	*13	iv	Jun. 14	July 13	Aug. 12	Sep. 10	Oct. 10	Nov. 8	Dec. 8	Jan. 6	Feb. 5	Mar. 6	Apr. 5	May 4	..
261	14	*v	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Apr. 23	May 23
262	15	vi	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	Apr. 13	May 12	..
*263	*16	vii*	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 2	.. 1	.. 1	..
*264	17	*viii	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 22	Apr. 20	May 20
265	18	ix	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	Apr. 10	May 9	..
266	*19	x	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Apr. 28	..
*267	1	*xi*	May 28	Jun. 26	July 26	Aug. 24	Sep. 23	Oct. 22	Nov. 21	.. 20	.. 19	.. 17	.. 18	.. 17	May 17
*268	2	xii	Jun. 16	July 15	Aug. 14	Sep. 12	Oct. 12	Nov. 10	Dec. 10	Jan. 8	Feb. 7	Mar. 8	Apr. 7	May 6	..
269	*3	*xiii	.. 5	.. 4	.. 3	.. 1	.. 1	Oct. 30	Nov. 29	Dec. 28	Jan. 27	Feb. 25	Mar. 27	Apr. 25	May 25
270	4	xiv	.. 24	.. 23	.. 22	.. 20	.. 20	Nov. 18	Dec. 18	Jan. 16	Feb. 15	Mar. 16	Apr. 15	May 14	..
*271	*5	xv	.. 13	.. 12	.. 11	.. 9	.. 9	.. 7	.. 7	.. 5	.. 4	.. 4	.. 3	May 2	..
*272	6	*xvi	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 23	Apr. 21	May 21

TABLE XXIII.—PART XVIII.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xviii.

Year.	Metonic Cycle. xv. xvi.	Hekkaidekaëteric Cycle xviii.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
273	7	i	Jun. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	Apr. 11	May 10	..
274	*8	ii	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar. 31	Apr. 29	..
*275	9	*iii*	May 29	Jun. 27	July 27	Aug. 25	Sep. 24	Oct. 23	Nov. 22	Dec. 21	.. 20	Feb. 18	.. 19	.. 18	May 18
*276	10	iv	Jun. 17	July 16	Aug. 15	Sep. 13	Oct. 13	Nov. 11	Dec. 11	Jan. 9	Feb. 8	Mar. 9	Apr. 8	May 7	..
277	*11	*v	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Apr. 26	May 26
278	12	vi	.. 25	.. 24	.. 23	.. 21	.. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	Apr. 16	May 15	..
*279	*13	vii*	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 5	.. 4	.. 4	..
*280	14	*viii	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 25	Apr. 23	May 23
281	15	ix	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	Apr. 13	May 12	..
282	*16	x	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	.. 2	.. 1	..
*283	17	*xi*	May 31	Jun. 29	July 29	Aug. 27	Sep. 26	Oct. 25	Nov. 24	Dec. 23	Jan. 22	Feb. 20	Mar. 21	Apr. 20	May 20
*284	18	xii	Jun. 19	July 18	Aug. 17	Sep. 15	Oct. 15	Nov. 13	Dec. 13	Jan. 11	Feb. 10	Mar. 11	Apr. 10	May 9	..
285	*19	*xiii	.. 8	.. 7	.. 6	.. 4	.. 4	.. 2	.. 2	Dec. 31	Jan. 30	Feb. 28	Mar. 30	Apr. 28	May 28
286	1	xiv	.. 27	.. 26	.. 25	.. 23	.. 23	.. 21	.. 21	Jan. 19	Feb. 18	Mar. 19	Apr. 18	May 17	..
*287	2	xv	.. 16	.. 15	.. 14	.. 12	.. 12	.. 10	.. 10	.. 8	.. 7	.. 7	.. 6	.. 5	..
*288	*3	*xvi	.. 4	.. 3	.. 2	Aug. 31	Sep. 30	Oct. 29	Nov. 28	Dec. 27	Jan. 26	Feb. 24	Mar. 26	Apr. 24	May 24

TABLE XXIII.—Part XIX.

Lunar Cycle, Type ii. Hekkaidekaëteric. Period i, Cycle xix.

Year.	Metonic Cycle xvi.	Hekkaidekaeteric Cycle xix.	Month. i. 29 d.	Month. ii. 30 d.	Month. iii. 29 d.	Month. iv. 30 d.	Month. v. 29 d.	Month. vi. 30 d.	Month. vii. 29 d.	Month. viii. 30 d.	Month. ix. 29 d.	Month. x. 30 d.	Month. xi. 29 d. Lp.-yr. 30 d. Lr.-yr. 30 d.	Month. xii. 30 d.	Month. xiii. 30 d.
289	4	i	Jun. 23	July 22	Aug. 21	Sep. 19	Oct. 19	Nov. 17	Dec. 17	Jan. 15	Feb. 14	Mar. 15	Apr. 14	May 13	..
290	*5	ii	.. 12	.. 11	.. 10	.. 8	.. 8	.. 6	.. 6	.. 4	.. 3	.. 4	.. 3	.. 2	..
*291	6	*iii*	.. 1	Jun. 30	July 30	Aug. 28	Sep. 27	Oct. 26	Nov. 25	Dec. 24	Jan. 23	Feb. 21	Mar. 22	Apr. 21	May 21
*292	7	iv	.. 20	July 19	Aug. 18	Sep. 16	Oct. 16	Nov. 14	Dec. 14	Jan. 12	Feb. 11	Mar. 12	Apr. 11	May 10	..
293	*8	*v	.. 9	.. 8	.. 7	.. 5	.. 5	.. 3	.. 3	.. 1	Jan. 31	.. 1	Mar. 31	Apr. 29	May 29
294	9	vi	.. 28	.. 27	.. 26	.. 24	.. 24	.. 22	.. 22	.. 20	Feb. 19	.. 20	Apr. 19	May 18	..
*295	10	vii*	.. 17	.. 16	.. 15	.. 13	.. 13	.. 11	.. 11	.. 9	.. 8	.. 8	.. 7	.. 7	..
*296	*11	*viii	.. 6	.. 5	.. 4	.. 2	.. 2	Oct. 31	Nov. 30	Dec. 29	Jan. 28	Feb. 26	Mar. 28	Apr. 26	May 26
297	12	ix	.. 25	.. 24	.. 23	.. 21	.. 21	Nov. 19	Dec. 19	Jan. 17	Feb. 16	Mar. 17	Apr. 16	May 15	..
298	*13	x	.. 14	.. 13	.. 12	.. 10	.. 10	.. 8	.. 8	.. 6	.. 5	.. 6	.. 5	.. 4	..
*299	14	*xi*	.. 3	.. 2	.. 1	Aug. 30	Sep. 29	Oct. 28	Nov. 27	Dec. 26	Jan. 25	Feb. 23	Mar. 24	Apr. 23	May 23
*300	15	xii	.. 22	.. 21	.. 20	Sep. 18	Oct. 18	Nov. 16	Dec. 16	Jan. 14	Feb. 13	Mar. 14	Apr. 13	May 12	..
301	*16	*xiii	.. 11	.. 10	.. 9	.. 7	.. 7	.. 5	.. 5	.. 3	.. 2	.. 3	.. 2	.. 1	May 31
302	17	xiv	.. 30	.. 29	.. 28	.. 26	.. 26	.. 24	.. 24	.. 22	.. 21	.. 22	.. 21	.. 20	..
*303	18	xv	.. 19	.. 18	.. 17	.. 15	.. 15	.. 13	.. 13	.. 11	.. 10	.. 10	.. 9	.. 8	Periodii,
*304	*19	xvi	.. 7	.. 6	.. 5	.. 3	.. 3	.. 1	.. 1	Dec. 30	Jan. 29	Feb. 27	Mar. 29	Apr. 28	Cycle i.

TABLE XXIV.—Part I.

Decrement of the Epoch in the Period of 304 mean Julian years, from Period i A. M. 1 B. C. 4004 to Period xx A. M. 5777 A. D. 1773.

Period.	A. M.	B. C.	Decrement of Epoch.		Midnight.
i	1	4004	0	Nisan 1	April 29
ii	305	3700	1	.. 1	.. 28
iii	609	3396	2	.. 1	.. 27
iv	913	3092	3	.. 1	.. 26
v	1217	2788	4	.. 1	.. 25
vi	1521	2484	5	.. 1	.. 24
vii	1825	2180	6	.. 1	.. 23
viii	2129	1876	7	.. 1	.. 22
ix	2433	1572	8	.. 1	.. 21
x	2737	1268	9	.. 1	.. 20
xi	3041	964	10	.. 1	.. 19
xii	3345	660	11	.. 1	.. 18
xiii	3649	356	12	.. 1	.. 17
xiv	3953	52	13	1	.. 16
	A. M.	A. D.			
xv	4257	253	14	Nisan 1	April 15
xvi	4561	557	15	.. 1	.. 14
xvii	4865	861	16	.. 1	.. 13
xviii	5169	1165	17	.. 1	.. 12
xix	5473	1469	18	.. 1	.. 11
xx	5777	1773	19	.. 1	.. 10

TABLE XXIV.—Part II.

Recession of mean Lunar time on Calendar or Cyclical in the Period of 304 mean Julian years, through every cycle of 19 years, or 235 mean lunations.

Cycle of 19 Years.	Period of 304 Years.	Number of the Lunation of the Period.	Day of the month or Epoch of the Period.	Ingress of the Cycle in mean solar time from midnt. h.	m.
i	1	1	N	0	0
ii	20	236	N−1	22	30
iii	39	471	N−1	21	0
iv	58	706	N−1	19	30
v	77	941	N−1	18	0
vi	96	1 176	N−1	16	30
vii	115	1 411	N−1	15	0
viii	134	1 646	N−1	13	30
ix	153	1 881	N−1	12	0
x	172	2 116	N−1	10	30
xi	191	2 351	N−1	9	0
xii	210	2 586	N−1	7	30
xiii	229	2 821	N−1	6	0
xiv	248	3 056	N−1	4	30
xv	267	3 291	N−1	3	0
xvi	286	3 526	N−1	1	30
i	305 = 1	3 761 = 1	N′	0	0

TABLE XXIV.—Part III.

Recession of mean Lunar time in the Hipparchean Period on the mean Cyclical standard of the Period, through one Cycle of 19 years, or 235 Lunations.

Cycle.	Sum of Lunations.	Recession. h.	m.	s.
i	0	0	0	0
ii	12		4	35·744 680 8
*iii	24		9	11·489 361 6
iv	37		14	10·212 765 8
*v	49		18	45·957 446 6
vi	62		23	44·680 850 8
vii	74		28	20·425 531 6
*viii	86		32	56·170 212 4
ix	99		37	54·893 616 6
x	111		42	30·638 297 4
*xi	123		47	6·382 978 2
xii	136		52	5·106 382 4
*xiii	148		56	40·851 063 2
xiv	161	1	1	39·574 467 4
xv	173	1	6	15·319 148 2
*xvi	185	1	10	51·063 829
xvii	198	1	15	49·787 233 2
xviii	210	1	20	25·531 914
*xix	222	1	25	1·276 594 8
i	235	1	29	59·999 999
	=	1	30	

TABLE XXV.

Sum of mean solar time, in days and nights, and in aliquot parts of days and nights, in the mean lunar month of the Fasti, from one month to 80 000.

Mean Lunar month.	Days and Nights.	h.	m.	s.	th.
One quarter.	7	9	11	0	38·297 872 340 425 531 914
One half.	14	18	22	1	16·595 744 680 851 063 828
Three quarters.	22	3	33	1	54·893 617 021 276 595 742
One month. 1	29	12	44	2	33·191 489 361 702 127 659
One month and ½.	44	7	6	3	49·787 234 042 553 191 487
2	59	1	28	5	6·382 978 723 404 255 318
3	88	14	12	7	39·574 468 085 106 382 977
4	118	2	56	10	12·765 957 446 808 510 636
5	147	15	40	12	45·957 446 808 510 638 295
6	177	4	24	15	19·148 936 170 212 765 954
7	206	17	8	17	52·340 425 531 914 893 613
8	236	5	52	20	25·531 914 893 617 021 272
9	265	18	36	22	58·723 404 255 319 148 931
10	295	7	20	25	31·914 893 617 021 276 590
11	324	20	4	28	5·106 382 978 723 404 249
12	354	8	48	30	38·297 872 340 425 531 908
13	383	21	32	33	11·489 361 702 127 659 567
20	590	14	40	51	3·829 787 234 042 553 18
30	885	22	1	16	35·744 680 851 063 829 77
40	1 181	5	21	42	7·659 574 468 085 106 36
50	1 476	12	42	7	39·574 468 085 106 382 95
60	1 771	20	2	33	11·489 361 702 127 659 54
70	2 067	3	22	58	43·404 255 319 148 936 13
80	2 362	10	43	24	15·319 148 936 170 212 72
90	2 657	18	3	49	47·234 042 553 191 489 31
100	2 953	1	24	15	19·148 936 170 212 765 90
200	5 906	2	48	30	38·297 872 340 425 531 8
300	8 859	4	12	45	57·446 808 510 638 297 7
400	11 812	5	37	1	16·595 744 680 851 063 6
500	14 765	7	1	16	35·744 680 851 063 829 5
600	17 718	8	25	31	54·893 617 021 276 595 4
700	20 671	9	49	47	14·042 553 191 489 361 3
800	23 624	11	14	2	33·191 489 361 702 127 2
900	26 577	12	38	17	52·340 425 531 914 893 1
1000	29 530	14	2	33	11·489 361 702 127 659
2000	59 061	4	5	6	22·978 723 404 255 318
3000	88 591	18	7	39	34·468 085 106 382 977
4000	118 122	8	10	12	45·957 446 808 510 636
5000	147 652	22	12	45	57·446 808 510 638 295
6000	177 183	12	15	19	8·936 170 212 765 954
7000	206 714	2	17	52	20·425 531 914 893 613
8000	236 244	16	20	25	31·914 893 617 021 272
9000	265 775	6	22	58	43·404 255 319 148 931
10 000	295 305	20	25	31	54·893 617 021 276 590
20 000	590 611	16	51	3	49·787 234 042 553 18
30 000	885 917	13	16	35	44·680 851 063 829 77
40 000	1 181 223	9	42	7	39·574 468 085 106 36
50 000	1 476 529	6	7	39	34·468 085 106 382 95
60 000	1 771 835	2	33	11	29·361 702 127 659 54
70 000	2 067 140	22	58	43	24·255 319 148 936 13
80 000	2 362 446	19	24	15	19·148 936 170 212 72

TABLE XXVI. Part I.—*Conversion of Degrees, Minutes, and Seconds of the Equator, into Hours, Minutes, and Seconds of mean time.*

	Time.		Time.			Time.		
			″	s.	th.	″	s.	th.
Degrees.	h.	m.	′	m.	s.	′	m.	s.
1		4	1		4	31	2	4
2		8	2		8	32	2	8
3		12	3		12	33	2	12
4		16	4		16	34	2	16
5		20	5		20	35	2	20
6		24	6		24	36	2	24
7		28	7		28	37	2	28
8		32	8		32	38	2	32
9		36	9		36	39	2	36
10		40	10		40	40	2	40
11		44	11		44	41	2	44
12		48	12		48	42	2	48
13		52	13		52	43	2	52
14		56	14		56	44	2	56
15	1	0	15	1	0	45	3	0
30	2		16	1	4	46	3	4
45	3		17	1	8	47	3	8
60	4		18	1	12	48	3	12
75	5		19	1	16	49	3	16
90	6		20	1	20	50	3	20
105	7		21	1	24	51	3	24
120	8		22	1	28	52	3	28
135	9		23	1	32	53	3	32
150	10		24	1	36	54	3	36
165	11		25	1	40	55	3	40
180	12		26	1	44	56	3	44
195	13		27	1	48	57	3	48
210	14		28	1	52	58	3	52
225	15		29	1	56	59	3	56
240	16		30	2	0	60	4	0
255	17							
270	18							
285	19							
300	20							
315	21							
330	22							
345	23							
360	24							

Decimal parts of Seconds of a degree.

″	th.
0·1	0·4
0·2	0·8
0·3	1·2
0·4	1·6
0·5	2·0
0·6	2·4
0·7	2·8
0·8	3·2
0·9	3·6
1·0	4·0

TABLE XXVI. Part II.—*Conversion of Hours, Minutes, and Seconds of mean time, into Degrees, Min. and Sec. of the Equator.*

		Space.			Space.		
		s.	′	″	s.	′	″
Hrs.	°	m.	°	′	m.	°	′
1	15	1		15	31	7	45
2	30	2		30	32	8	0
3	45	3		45	33	8	15
4	60	4	1	0	34	8	30
5	75	5	1	15	35	8	45
6	90	6	1	30	36	9	0
7	105	7	1	45	37	9	15
8	120	8	2	0	38	9	30
9	135	9	2	15	39	9	45
10	150	10	2	30	40	10	0
11	165	11	2	45	41	10	15
12	180	12	3	0	42	10	30
13	195	13	3	15	43	10	45
14	210	14	3	30	44	11	0
15	225	15	3	45	45	11	15
16	240	16	4	0	46	11	30
17	255	17	4	15	47	11	45
18	270	18	4	30	48	12	0
19	285	19	4	45	49	12	15
20	300	20	5	0	50	12	30
21	315	21	5	15	51	12	45
22	330	22	5	30	52	13	0
23	345	23	5	45	53	13	15
24	360	24	6	0	54	13	30
		25	6	15	55	13	45
		26	6	30	56	14	0
		27	6	45	57	14	15
		28	7	0	58	14	30
		29	7	15	59	14	45
		30	7	30	60	15	0

Decimal parts of Seconds of mean time.

sec.	″
0·1	1·5
0·2	3·0
0·3	4·5
0·4	6·0
0·5	7·5
0·6	9·0
0·7	10·5
0·8	12·0
0·9	13·5
1·0	15·0

TABLE XXVII.

Cycle of the Meridian Restitution, or of the return of the mean Sun and of the mean Equinoctial point to the Meridian of the Epoch. In Periods of 129 *mean tropical years of the Fasti.*

			A[a] Space.			Aa[b] Time.				B[c] Space.			Bb[d] Time.			
Period.	A. M.	B. C.	Deg.	m.	s.	h.	m.	s.	th.	Deg.	m.	s.	h.	m.	s.	th.
i	1	4004	357	12	36	23	48	50	24	2	47	24	0	11	9	36
ii	130	3875	87	18	0	5	49	12	0	272	42	0	18	10	48	0
iii	259	3746	177	23	24	11	49	33	36	182	36	36	12	10	26	24
iv	388	3617	267	28	48	17	49	55	12	92	31	12	6	10	4	48
v	517	3488	357	34	12	23	50	16	48	2	25	48	0	9	43	12
vi	646	3359	87	39	36	5	50	38	24	272	20	24	18	9	21	36
vii	775	3230	177	45	0	11	51	0	0	182	15	0	12	9	0	0
viii	904	3101	267	50	24	17	51	21	36	92	9	36	6	8	38	24
ix	1033	2972	357	55	48	23	51	43	12	2	4	12	0	8	16	48
x	1162	2843	88	1	12	5	52	4	48	271	58	48	18	7	55	12
xi	1291	2714	178	6	36	11	52	26	24	181	53	24	12	7	33	36
xii	1420	2585	268	12	0	17	52	48	0	91	48	0	6	7	12	0
xiii	1549	2456	358	17	24	23	53	9	36	1	42	36	0	6	50	24
xiv	1678	2327	88	22	48	5	53	31	12	271	37	12	18	6	28	48
xv	1807	2198	178	28	12	11	53	52	48	181	31	48	12	6	7	12
xvi	1936	2069	268	33	36	17	54	14	24	91	26	24	6	5	45	36
xvii	2065	1940	358	39	0	23	54	36	0	1	21	0	0	5	24	0
xviii	2194	1811	88	44	24	5	54	57	36	271	15	36	18	5	2	24
xix	2323	1682	178	49	48	11	55	19	12	181	10	12	12	4	40	48
xx	2452	1553	268	55	12	17	55	40	48	91	4	48	6	4	19	12
*xxi	2581	1424	179	0	36	11	56	2	24	180	59	24	12	3	57	36
xxii	2710	1295	269	6	0	17	56	24	0	90	54	0	6	3	36	0
xxiii	2839	1166	359	11	24	23	56	45	36	0	48	36	0	3	14	24
xxiv	2968	1037	89	16	48	5	57	7	12	270	43	12	18	2	52	48
xxv	3097	908	179	22	12	11	57	28	48	180	37	48	12	2	31	12
xxvi	3226	779	269	27	36	17	57	50	24	90	32	24	6	2	9	36
*xxvii	3355	650	179	33	0	11	58	12	0	180	27	0	12	1	48	0
xxviii	3484	521	269	38	24	17	58	33	36	90	21	36	6	1	26	24
xxix	3613	392	359	43	48	23	58	55	12	0	16	12	0	1	4	48
xxx	3742	263	89	49	12	5	59	16	48	270	10	48	18	0	43	12
xxxi	3871	134	179	54	36	11	59	38	24	180	5	24	12	0	21	36
xxxii	4000	5	270	0	0	18	0	0	0	90	0	0	6	0	0	0
	+ 1	− 1	+ 87	12	36	+ 5	48	50	24	− 87	12	36	− 5	48	50	24
	4001	4	357	12	36	23	48	50	24	2	47	24	0	11	9	36

[a] A—The numbers in this column should be raised 2° 52′ 48″ throughout.

[b] Aa—Those in this column should be raised 11 m. 31 s. 12 th. throughout.

[c] B—Those in this column should be lowered 2° 52′ 48″ throughout.

[d] Bb—Those in this column should be lowered 11 m. 31 s 12 th. throughout.

TABLE XXVIII.

Sum of mean solar time in integral days and decimal parts of a day, in the mean Tropical year of the Fasti, from one year to 7000.

Cf. the Introduction, 236. Part iii. ch. i. sect. xv.

Years.	Days.
1	365·242 25
2	730·484 50
3	1 095·726 75
4	1 460·969 00
5	1 826·211 25
6	2 191·453 50
7	2 556·695 75
8	2 921·938 00
9	3 287·180 25
10	3 652·422 50
20	7 304·845 0
30	10 957·267 5
40	14 609·690 0
50	18 262·112 5
60	21 914·535 0
70	25 566·957 5
80	29 219·380 0
90	32 871·802 5
100	36 524·225
200	73 048·450
300	109 572·675
400	146 096·900
500	182 621·125
600	219 145·350
700	255 669·575
800	292 193·800
900	328 718·025
1000	365 242·250
2000	730 484·50
3000	1 095 726·75
4000	1 460 969·00
5000	1 826 211·25
6000	2 191 453·50
7000	2 556 695·75

TAB. XXIX.—*Sum of mean solar time in mean solar days and nights, in the Equable, Cyc., or Nabonass. year, from one to 7000 Equable years.*

Equable Years.	Days.
1	365
2	730
3	1 095
4	1 460
5	1 825
6	2 190
7	2 555
8	2 920
9	3 285
10	3 650
20	7 300
30	10 950
40	14 600
50	18 250
60	21 900
70	25 550
80	29 200
90	32 850
100	36 500
200	73 000
300	109 500
400	146 000
500	182 500
600	219 000
700	255 500
800	292 000
900	328 500
1000	365 000
2000	730 000
3000	1 095 000
4000	1 460 000
5000	1 825 000
6000	2 190 000
7000	2 555 000

TAB. XXX.—*Sum of mean solar time in mean solar days and nights, in the mean Tropical year of the Fasti, from one to 7000 Tropical years.*

Tropical Years.	Days.	h.	m.	s.	th.
1	365	5	48	50	24
2	730	11	37	40	48
3	1 095	17	26	31	12
4	1 460	23	15	21	36
5	1 826	5	4	12	0
6	2 191	10	53	2	24
7	2 556	16	41	52	48
8	2 921	22	30	43	12
9	3 287	4	19	33	36
10	3 652	10	8	24	0
20	7 304	20	16	48	
30	10 957	6	25	12	
40	14 609	16	33	36	
50	18 262	2	42	0	
60	21 914	12	50	24	
70	25 566	22	58	48	
80	29 219	9	7	12	
90	32 871	19	15	36	
100	36 524	5	24		
200	73 048	10	48		
300	109 572	16	12		
400	146 096	21	36		
500	182 621	3	0		
600	219 145	8	24		
700	255 669	13	48		
800	292 193	19	12		
900	328 718	0	36		
1000	365 242	6			
2000	730 484	12			
3000	1 095 726	18			
4000	1 460 969	0			
5000	1 826 211	6			
6000	2 191 453	12			
7000	2 556 695	18			

TAB. XXXI.—*Sum of mean solar time in mean solar days and nights, in the mean Julian year, from one to 7000 Julian years.*

Julian Years.	Days.	h.
1	365	6
2	730	12
3	1 095	18
4	1 461	
5	1 826	6
6	2 191	12
7	2 556	18
8	2 922	
9	3 287	6
10	3 652	12
20	7 305	
30	10 957	12
40	14 610	
50	18 262	12
60	21 915	
70	25 567	12
80	29 220	
90	32 872	12
100	36 525	
200	73 050	
300	109 575	
400	146 100	
500	182 625	
600	219 150	
700	255 675	
800	292 200	
900	328 725	
1000	365 250	
2000	730 500	
3000	1 095 750	
4000	1 461 000	
5000	1 826 250	
6000	2 191 500	
7000	2 556 750	

TABLE XXXII.—*Sum of mean solar time in mean solar days and nights, in the mean Sidereal year of the Fasti, from one to 7000 Sidereal years.*

Sidereal Years.	Days.	h.	m.	s.
1	365	6	9	9·567 454 798 331
2	730	12	18	19·134 909 596 662
3	1 095	18	27	28·702 364 394 993
4	1 461	0	36	38·269 819 193 324
5	1 826	6	45	47·837 273 991 655
6	2 191	12	54	57·404 728 789 986
7	2 556	19	4	6·972 183 588 317
8	2 922	1	13	16·539 638 386 648
9	3 287	7	22	26·107 093 184 979
10	3 652	13	31	35·674 547 983 31
20	7 305	3	3	11·349 095 966 62
30	10 957	16	34	47·023 643 949 93
40	14 610	6	6	22·698 191 933 24
50	18 262	19	37	58·372 739 916 55
60	21 915	9	9	34·047 287 899 86
70	25 567	22	41	9·721 835 883 17
80	29 220	12	12	45·396 383 866 48
90	32 873	1	44	21·070 931 849 79
100	36 525	15	15	56·745 479 833 1
200	73 051	6	31	53·490 959 666 2
300	109 576	21	47	50·236 439 499 3
400	146 102	13	3	46·981 919 332 4
500	182 628	4	19	43·727 399 165 5
600	219 153	19	35	40·472 878 998 6
700	255 679	10	51	37·218 358 831 7
800	292 205	2	7	33·963 838 664 8
900	328 730	17	23	30·709 318 497 9
1000	365 256	8	39	27·454 798 331
2000	730 512	17	18	54·909 596 662
3000	1 095 769	1	58	22·364 394 993
4000	1 461 025	10	37	49·819 193 324
5000	1 826 281	19	17	17·273 991 655
6000	2 191 538	3	56	44·728 789 986
7000	2 556 794	12	36	12·183 588 317

TABLE XXXIII.

Sum of mean solar time in mean solar days and nights, in the mean Anomalistic year of the Fasti, from one to 7000 Anomalistic years.

Anomalistic yrs.	Days.	h.	m.	s.
1	365	6	13	53·482 430 464 842 2
2	730	12	27	46·964 860 929 684 4
3	1 095	18	41	40·447 291 394 526 6
4	1 461	0	55	33·929 721 859 368 8
5	1 826	7	9	27·412 152 324 211
6	2 191	13	23	20·894 582 789 053 2
7	2 556	19	37	14·377 013 253 895 4
8	2 922	1	51	7·859 443 718 737 6
9	3 287	8	5	1·341 874 183 579 8
10	3 652	14	18	54·824 304 648 422
20	7 305	4	37	49·648 609 296 844
30	10 957	18	56	44·472 913 945 266
40	14 610	9	15	39·297 218 593 688
50	18 262	23	34	34·121 523 242 11
60	21 915	13	53	28·945 827 890 532
70	25 568	4	12	23·770 132 538 954
80	29 220	18	31	18·594 437 187 376
90	32 873	8	50	13·418 741 835 798
100	36 525	23	9	8·243 046 484 22
200	73 051	22	18	16·486 092 968 44
300	109 577	21	27	24·729 139 452 66
400	146 103	20	36	32·972 185 936 88
500	182 629	19	45	41·215 232 421 1
600	219 155	18	54	49·458 278 905 32
700	255 681	18	3	57·701 325 389 54
800	292 207	17	13	5·944 371 873 76
900	328 733	16	22	14·187 418 357 98
1000	365 259	15	31	22·430 464 842 2
2000	730 519	7	2	44·860 929 684 4
3000	1 095 778	22	34	7·291 394 526 6
4000	1 461 038	14	5	29·721 859 368 8
5000	1 826 298	5	36	52·152 324 211
6000	2 191 557	21	8	14·582 789 053 2
7000	2 556 817	12	39	37·013 253 895 4

TABLE XXXIV.—*Precession of the mean Julian yr. on the mean Tropical of the Fasti, from one to 7000 yrs.*

Years.	Days.	h.	m.	s.	th.
1	..	..	11	9	36
2	..	..	22	19	12
3	..	..	33	28	48
4	..	..	44	38	24
5	..	..	55	48	
6	..	1	6	57	36
7	..	1	18	7	12
8	..	1	29	16	48
9	..	1	40	26	24
10	..	1	51	36	
20	..	3	43	12	
30	..	5	34	48	
40	..	7	26	24	
50	..	9	18	..	
60	..	11	9	36	
70	..	13	1	12	
80	..	14	52	48	
90	..	16	44	24	
100	..	18	36		
200	1	13	12		
300	2	7	48		
400	3	2	24		
500	3	21	..		
600	4	15	36		
700	5	10	12		
800	6	4	48		
900	6	23	24		
1000	7	18			
2000	15	12			
3000	23	6			
4000	31	..			
5000	38	18			
6000	46	12			
7000	54	6			

TABLE XXXV.—*Precession of the mean Sidereal year of the Fasti on the mean Tropical, from one to 7000 years.*

Years.	Days.	h.	m.	s.
1	..	..	20	19·167 454 798 331
2	..	..	40	38·334 909 596 662
3	..	1	0	57·502 364 394 993
4	..	1	21	16·669 819 193 324
5	..	1	41	35·837 273 991 655
6	..	2	1	55·004 728 789 986
7	..	2	22	14·172 183 588 317
8	..	2	42	33·339 638 386 648
9	..	3	2	52·507 093 184 979
10	..	3	23	11·674 547 983 31
20	..	6	46	23·349 095 966 62
30	..	10	9	35·023 643 949 93
40	..	13	32	46·698 191 933 24
50	..	16	55	58·372 739 916 55
60	..	20	19	10·047 287 899 86
70	..	23	42	21·721 835 883 17
80	1	3	5	33·396 383 866 48
90	1	6	28	45·070 931 849 79
100	1	9	51	56·745 479 833 1
200	2	19	43	53·490 959 666 2
300	4	5	35	50·236 439 499 3
400	5	15	27	46·981 919 332 4
500	7	1	19	43·727 399 165 5
600	8	11	11	40·472 878 998 6
700	9	21	3	37·218 358 831 7
800	11	6	55	33·963 838 664 8
900	12	16	47	30·709 318 497 9
1000	14	2	39	27·454 798 331
2000	28	5	18	54·909 596 662
3000	42	7	58	22·364 394 993
4000	56	10	37	49·819 193 324
5000	70	13	17	17·273 991 655
6000	84	15	56	44·728 789 986
7000	98	18	36	12·183 588 317

TABLE XXXVI.—*Precession of the mean Anomalistic year of the Fasti on the mean Tropical, from one to 7000 years.*

Years.	Days.	h.	m.	s.
1	..	..	25	3·082 430 464 842 2
2	..	..	50	6·164 860 929 684 4
3	..	1	15	9·247 291 394 526 6
4	..	1	40	12·329 721 859 368 8
5	..	2	5	15·412 152 324 211
6	..	2	30	18·494 582 789 053 2
7	..	2	55	21·577 013 253 895 4
8	..	3	20	24·659 443 718 737 6
9	..	3	45	27·741 874 183 579 8
10	..	4	10	30·824 304 648 422
20	..	8	21	1·648 609 296 844
30	..	12	31	32·472 913 945 266
40	..	16	42	3·297 218 593 688
50	..	20	52	34·121 523 242 110
60	1	1	3	4·945 827 890 532
70	1	5	13	35·770 132 538 954
80	1	9	24	6·594 437 187 376
90	1	13	34	37·418 741 835 798
100	1	17	45	8·243 046 484 22
200	3	11	30	16·486 092 968 44
300	5	5	15	24·729 139 452 66
400	6	23	0	32·972 185 936 88
500	8	16	45	41·215 232 421 1
600	10	10	30	49·458 278 905 32
700	12	4	15	57·701 325 389 54
800	13	22	1	5·944 371 873 76
900	15	15	46	14·187 418 357 98
1000	17	9	31	22·430 464 842 2
2000	34	19	2	44·860 929 684 4
3000	52	4	34	7·291 394 526 6
4000	69	14	5	29·721 859 368 8
5000	86	23	36	52·152 324 211
6000	104	9	8	14·582 789 053 2
7000	121	18	39	37·013 253 895 4

TABLE XXXVII.—*Precession of the mean Sidereal year of the Fasti on the mean Julian, from one to 7000 years.*

Years.	Days.	h.	m.	s.
1			9	9·567 454 798 331
2			18	19·134 909 596 662
3			27	28·702 364 394 993
4			36	38·269 819 193 324
5			45	47·837 273 991 655
6			54	57·404 728 789 986
7		1	4	6·972 183 588 317
8		1	13	16·539 638 386 648
9		1	22	26.107 093 184 979
10		1	31	35·674 547 983 31
20		3	3	11·349 095 966 62
30		4	34	47·023 643 949 93
40		6	6	22·698 191 933 24
50		7	37	58·372 739 916 55
60		9	9	34·047 287 899 86
70		10	41	9·721 835 883 17
80		12	12	45·396 383 866 48
90		13	44	21·070 931 849 79
100		15	15	56·745 479 833 1
200	1	6	31	53·490 959 666 2
300	1	21	47	50·236 439 499 3
400	2	13	3	46·981 919 332 4
500	3	4	19	43·727 399 165 5
600	3	19	35	40·472 878 998 6
700	4	10	51	37·218 358 831 7
800	5	2	7	33·963 838 664 8
900	5	17	23	30·709 318 497 9
1000	6	8	39	27·454 798 331
2000	12	17	18	54·909 596 662
3000	19	1	58	22·364 394 993
4000	25	10	37	49·819 193 324
5000	31	19	17	17·273 991 655
6000	38	3	56	44·728 789 986
7000	44	12	36	12·183 588 317

TABLE XXXVIII.—*Precession of the mean Anomalistic year of the Fasti on the mean Julian, from one to 7000 years.*

Years.	Days.	h.	m.	s.
1			13	53·482 430 464 842 2
2			27	46·964 860 929 684 4
3			41	40·447 291 394 526 6
4			55	33·929 721 859 368 8
5		1	9	27·412 152 324 211
6		1	23	20·894 582 789 053 2
7		1	37	14·377 013 253 895 4
8		1	51	7·859 443 718 737 6
9		2	5	1·341 874 183 579 8
10		2	18	54·824 304 648 422
20		4	37	49·648 609 296 844
30		6	56	44·472 913 945 266
40		9	15	39·297 218 593 688
50		11	34	34·121 523 242 11
60		13	53	28·945 827 890 532
70		16	12	23·770 132 538 954
80		18	31	18·594 437 187 376
90		20	50	13·418 741 835 798
100		23	9	8·243 046 484 220
200	1	22	18	16·486 092 968 44
300	2	21	27	24·729 139 452 66
400	3	20	36	32·972 185 936 88
500	4	19	45	41·215 232 421 1
600	5	18	54	49·458 278 905 32
700	6	18	3	57·701 325 389 54
800	7	17	13	5·944 371 873 76
900	8	16	22	14·187 418 357 98
1000	9	15	31	22·430 464 842 2
2000	19	7	2	44·860 929 684 4
3000	28	22	34	7·291 394 526 6
4000	38	14	5	29·721 859 368 8
5000	48	5	36	52·152 324 211
6000	57	21	8	14·582 789 053 2
7000	67	12	39	37·013 253 895 4

TABLE XXXIX.—*Precession of the mean Anomalistic year of the Fasti on the mean Sidereal, from one to 7000 years.*

Years.	Days.	h.	m.	s.
1			4	43·914 975 666 511 2
2			9	27·829 951 333 022 4
3			14	11·744 926 999 533 6
4			18	55·659 902 666 044 8
5			23	39·574 878 332 556
6			28	23·489 853 999 067 2
7			33	7·404 829 665 578 4
8			37	51·319 805 332 089 6
9			42	35·234 780 998 600 8
10			47	19·149 756 665 112
20		1	34	38·299 513 330 224
30		2	21	57·449 269 995 336
40		3	9	16·599 026 660 448
50		3	56	35·748 783 325 560
60		4	43	54·898 539 990 672
70		5	31	14·048 296 655 784
80		6	18	33·198 053 320 896
90		7	5	52·347 809 986 008
100		7	53	11·497 566 651 12
200		15	46	22·995 133 302 24
300		23	39	34·492 699 953 36
400	1	7	32	45·990 266 604 48
500	1	15	25	57·487 833 255 6
600	1	23	19	8·985 399 906 72
700	2	7	12	20·482 966 557 84
800	2	15	5	31·980 533 208 96
900	2	22	58	43·478 099 860 08
1000	3	6	51	54·975 666 511 2
2000	6	13	43	49·951 333 022 4
3000	9	20	35	44·926 999 533 6
4000	13	3	27	39·902 666 044 8
5000	16	10	19	34·878 332 556
6000	19	17	11	29·853 999 067 2
7000	23	0	3	24·829 665 578 4

TABLE XL.

Diurnal Acceleration of the mean Sidereal day on the mean Solar day, in mean Sidereal time; from one day to 365 days.

Days.	h.	m.	s.
1		3	56·555 327 320 429 104
2		7	53·110 654 640 858 208
3		11	49·665 981 961 287 312
4		15	46·221 309 281 716 416
5		19	42·776 636 602 145 520
6		23	39·331 963 922 574 624
7		27	35·887 291 243 003 728
8		31	32·442 618 563 432 832
9		35	28·997 945 883 861 936
10		39	25·553 273 204 291 040
11		43	22·108 600 524 720 144
12		47	18·663 927 845 149 248
13		51	15·219 255 165 578 352
14		55	11·774 582 486 007 456
15		59	8·329 909 806 436 560
16	1	3	4·885 237 126 865 664
17	1	7	1·440 564 447 294 768
18	1	10	57·995 891 767 723 872
19	1	14	54·551 219 088 152 976
20	1	18	51·106 546 408 582 080
21	1	22	47·661 873 729 011 184
22	1	26	44·217 201 049 440 288
23	1	30	40·772 528 369 869 392
24	1	34	37·327 855 690 298 496
25	1	38	33·883 183 010 727 6
26	1	42	30·438 510 331 156 704
27	1	46	26·993 837 651 585 808
28	1	50	23·549 164 972 014 912
29	1	54	20·104 492 292 444 016
30	1	58	16·659 819 612 873 12
31	2	2	13·215 146 933 302 224

Months.	Days.	h.	m.	s.
1	30	1	58	16·659 819 612 873 12
2	60	3	56	33·319 639 225 746 24
3	90	5	54	49·979 458 838 619 36
4	120	7	53	6·639 278 451 492 48
5	150	9	51	23·299 098 064 365 6
6	180	11	49	39·958 917 677 238 72
7	210	13	47	56·618 737 290 111 84
8	240	15	46	13·278 556 902 984 96
9	270	17	44	29·938 376 515 858 08
10	300	19	42	46·598 196 128 731 2
11	330	21	41	3·258 015 741 604 32
12	360	23	39	19·917 835 354 477 44
	5	=	19	42·776 636 602 145 52
	365	23	59	2·694 471 956 622 96

TABLE XLI.—Part I.

Conversion of hours of mean Solar time into mean Sidereal: or Complement of mean Solar hours in mean Sidereal time, from one hour to 24.

Hrs.	m.	s.
1		9·856 471 971 684 546
2		19·712 943 943 369 092
3		29·569 415 915 053 638
4		39·425 887 886 738 184
5		49·282 359 858 422 730
6		59·138 831 830 107 276
7	1	8·995 303 801 791 822
8	1	18·851 775 773 476 368
9	1	28·708 247 745 160 914
10	1	38·564 719 716 845 460
11	1	48·421 191 688 530 006
12	1	58·277 663 660 214 552
13	2	8·134 135 631 899 098
14	2	17·990 607 603 583 644
15	2	27·847 079 575 268 190
16	2	37·703 551 546 952 736
17	2	47·560 023 518 637 282
18	2	57·416 495 490 321 828
19	3	7·272 967 462 006 374
20	3	17·129 439 433 690 920
21	3	26·985 911 405 375 466
22	3	36·842 383 377 060 012
23	3	46·698 855 348 744 558
24	3	56·555 327 320 429 104

TABLE XLI.—Part II.

Conversion of minutes of mean Solar time into mean Sidereal: or Complement of the mean Solar minute in mean Sidereal time, from one minute to 60.

Min.	Sec.	Min.	Sec.
1	0·164 274 532 861 409 1	31	5·092 510 518 703 682 1
2	0·328 549 065 722 818 2	32	5·256 785 051 565 091 2

TABLE XLI.—Part III.

Conversion of seconds of mean Solar time into mean Sidereal: or Complement of the mean Solar second in mean Sidereal time from one second to 60: also of decimal parts of the mean Solar second, from one to ten.

Sec.	Sec.	Sec.	Sec.
1	0·002 737 908 881 023 485	31	0·084 875 175 311 728 035
2	0·005 475 817 762 046 97	32	0·087 613 084 192 751 52
3	[illegible]	33	0·090 350 993 073 775 005

Diurnal Anticipation
mean S

Days.	h.	m.	s.
1	..	3	55·909 428 80
2	..	7	51·818 857 60
3	..	11	47·728 286 40
4	..	15	43·637 715 20
5	..	19	39·547 144 00
6	..	23	35·456 572 80
7	..	27	31·366 001 60
8	..	31	27·275 430 40
9	..	35	23·184 859 20
10	.	39	19·094 288 00
11	..	43	15·003 716 80
12	.	47	10·913 145 60
13	..	51	6·822 574 40
14	..	55	2·732 003 20
15	..	58	58·641 432 00
16	1	2	54·550 860 80
17	1	6	50·460 289 60
18	1	10	46·369 718 40
19	1	14	42·279 147 20
20	1	18	38·188 576 00
21	1	22	34·098 004 80
22	1	26	30·007 433 60
23	1	30	25·916 862 40
24	1	34	21·826 291 20
25	1	38	17·735 720 00
26	1	42	13·645 148 80
27	1	46	9·554 577 60
28	1	50	5·464 006 40
29	1	54	1·373 435 20
30	1	57	57·282 864 00
31	2	1	53·192 292 80

23	3·767 997 821 114 303 46
24	3·931 823 813 336 664 48
25	4·095 649 805 559 025 5
26	4·259 475 797 781 386 52
27	4·423 301 790 003 747 54
28	4·587 127 782 226 108 56
29	4·750 953 774 448 469 58
30	4·914 779 766 670 830 6

53	8·682 777 587 785 134 00
54	8·846 603 580 007 495 08
55	9·010 429 572 229 856 1
56	9·174 255 564 452 217 12
57	9·338 081 556 674 578 14
58	9·501 907 548 896 939 16
59	9·665 733 541 119 300 18
60	9·829 559 533 341 661 2

21	3	[illegible]
22	3	36·250 309 733 516 546 4
23	3	46·079 869 266 858 207 6
24	3	55·909 428 800 199 868 8

TABLE XLI.—Part I.

Conversion of hours of mean Solar time into mean Sidereal: or Complement of mean Solar hours in mean Sidereal time, from one hour to 24.

Hrs.	m.	s.
1		9.856 471 971 684 546
2		19.712 943 943 369 092
3		29.569 415 915 053 638

TABLE XL.

Diurnal Acceleration of the mean Sidereal day on the mean Solar day, in mean Sidereal time; from one day to 365 days.

Days.	h.	m.	s.
1		3	56.555 327 320 429 104
2		7	53.110 654 640 858 208
3		11	49.665 981 961 287 312

Months.	Days.	h.	m.	s.
1	30	1	58	16.659 819 612 873 12
2	60	3	56	33.319 639 225 746 24
3	90	5	54	49.979 458 838 619 36

0 199 868 8
0 399 737 6
0 599 606 4
0 799 475 2
0 999 344
1 199 212 8
1 399 081 6
1 598 950 4
1 798 819 2
1 998 688
2 198 556 8
2 398 425 6
2 598 294 4
2 798 163 2
2 998 032
3 197 900 8
3 397 769 6
3 597 638 4
3 797 507 2
3 997 376
4 197 244 8
4 397 113 6
4 596 982 4
4 796 851 2
4 996 72
5 196 588 8
5 396 457 6
5 596 326 4
5 796 195 2
5 996 064
6 195 932 8

TABLE XLII.

...of the mean Sidereal day on the mean Solar day, in ...olar time, from one day to 365 days.

Months.	Days.	h.	m.	s.
1	30	1	57	57.282 864 005 996 064
2	60	3	55	54.565 728 011 992 128
3	90	5	53	51.848 592 017 988 192
4	120	7	51	49.131 456 023 984 256
5	150	9	49	46.414 320 029 980 32
6	180	11	47	43.697 184 035 976 384
7	210	13	45	40.980 048 041 972 448
8	240	15	43	38.262 912 047 968 512
9	270	17	41	35.545 776 053 964 576
10	300	19	39	32.828 640 059 960 64
11	330	21	37	30.111 504 065 956 704
12	360	23	35	27.394 368 071 952 768
	5	—	19	39.547 144 000 999 344
	365	23	55	6.941 512 072 952 112

TABLE XLIII.—Part I.

Conversion of hours of mean Sidereal time into mean solar: or Correction of the mean Sidereal hour, from one hour to 24.

Hrs.	m.	s.
1		9·829 559 533 341 661 2
2		19·659 119 066 683 322 4
3		29·488 678 600 024 983 6
4		39·318 238 133 366 644 8
5		49·147 797 666 708 306
6		58·977 357 200 049 967 2
7	1	8·806 916 733 391 628 4
8	1	18·636 476 266 733 289 6
9	1	28·466 035 800 074 950 8
10	1	38·295 595 333 416 612
11	1	48·125 154 866 758 273 2
12	1	57·954 714 400 099 934 4
13	2	7·784 273 933 441 595 6
14	2	17·613 833 466 783 256 8
15	2	27·443 393 000 124 918
16	2	37·272 952 533 466 579 2
17	2	47·102 512 066 808 240 4
18	2	56·932 071 600 149 901 6
19	3	6·761 631 133 491 562 8
20	3	16·591 190 666 833 224
21	3	26·420 750 200 174 885 2
22	3	36·250 309 733 516 546 4
23	3	46·079 869 266 858 207 6
24	3	55·909 428 800 199 868 8

TABLE XLIII.—Part II.

Conversion of minutes of mean Sidereal time into mean solar: or Correction of the mean Sidereal minute, from one minute to 60.

Min.	Sec.	Min.	Sec.
1	0·163 825 992 222 361 02	31	5·078 605 758 893 191 62
2	0·327 651 984 444 722 04	32	5·242 431 751 115 552 64
3	0·491 477 976 667 083 06	33	5·406 257 743 337 913 66
4	0·655 303 968 889 444 08	34	5·570 083 735 560 274 68
5	0·819 129 961 111 805 1	35	5·733 909 727 782 635 7
6	0·982 955 953 334 166 12	36	5·897 735 720 004 996 72
7	1·146 781 945 556 527 14	37	6·061 561 712 227 357 74
8	1·310 607 937 778 888 16	38	6·225 387 704 449 718 76
9	1·474 433 930 001 249 18	39	6·389 213 696 672 079 78
10	1·638 259 922 223 610 2	40	6·553 039 688 894 440 8
11	1·802 085 914 445 971 22	41	6·716 865 681 116 801 82
12	1·965 911 906 668 332 24	42	6·880 691 673 339 162 84
13	2·129 737 898 890 693 26	43	7·044 517 665 561 523 86
14	2·293 563 891 113 054 28	44	7·208 343 657 783 884 88
15	2·457 389 883 335 415 3	45	7·372 169 650 006 245 9
16	2·621 215 875 557 776 32	46	7·535 995 642 228 606 92
17	2·785 041 867 780 137 34	47	7·699 821 634 450 967 94
18	2·948 867 860 002 498 36	48	7·863 647 626 673 328 96
19	3·112 693 852 224 859 38	49	8·027 473 618 895 689 98
20	3·276 519 844 447 220 4	50	8·191 299 611 118 051
21	3·440 345 836 669 581 42	51	8·355 125 603 340 412 02
22	3·604 171 828 891 942 44	52	8·518 951 595 562 773 04
23	3·767 997 821 114 303 46	53	8·682 777 587 785 134 06
24	3·931 823 813 336 664 48	54	8·846 603 580 007 495 08
25	4·095 649 805 559 025 5	55	9·010 429 572 229 856 1
26	4·259 475 797 781 386 52	56	9·174 255 564 452 217 12
27	4·423 301 790 003 747 54	57	9·338 081 556 674 578 14
28	4·587 127 782 226 108 56	58	9·501 907 548 896 939 16
29	4·750 953 774 448 469 58	59	9·665 733 541 119 300 18
30	4·914 779 766 670 830 6	60	9·829 559 533 341 661 2

TABLE XLIII.—Part III.

Conversion of seconds of mean Sidereal time into mean Solar: or Correction of the mean Sidereal second, from one second to sixty; and of decimal parts of the mean Sidereal second, from one to ten.

Sec.	Sec.	Sec.	Sec.
1	0.002 730 433 203 706 017	31	0·084 643 429 314 886 527
2	0.005 460 866 407 412 034	32	0·087 373 862 518 592 544
3	0.008 191 299 611 118 051	33	0·090 104 295 722 298 561
4	0.010 921 732 814 824 068	34	0·092 834 728 926 004 578
5	0.013 652 166 018 530 085	35	0·095 565 162 129 710 595
6	0.016 382 599 222 236 102	36	0·098 295 595 333 416 612
7	0.019 113 032 425 942 119	37	0·101 026 028 537 122 629
8	0.021 843 465 629 648 136	38	0·103 756 461 740 828 646
9	0·024 573 898 833 354 153	39	0·106 486 894 944 534 663
10	0·027 304 332 037 060 17	40	0·109 217 328 148 240 68
11	0·030 034 765 240 766 187	41	0·111 947 761 351 946 697
12	0·032 765 198 444 472 204	42	0·114 678 194 555 652 714
13	0·035 495 631 648 178 221	43	0·117 408 627 759 358 731
14	0·038 226 064 851 884 238	44	0·120 139 060 963 064 748
15	0·040 956 498 055 590 255	45	0·122 869 494 166 770 765
16	0·043 686 931 259 296 272	46	0·125 599 927 370 476 782
17	0·046 417 364 463 002 289	47	0·128 330 360 574 182 799
18	0·049 147 797 666 708 306	48	0·131 060 793 777 888 816
19	0·051 878 230 870 414 323	49	0·133 791 226 981 594 833
20	0·054 608 664 074 120 34	50	0·136 521 660 185 300 85
21	0·057 339 097 277 826 357	51	0·139 252 093 389 006 867
22	0·060 069 530 481 532 374	52	0·141 982 526 592 712 884
23	0·062 799 963 685 238 391	53	0·144 712 959 796 418 901
24	0·065 530 396 888 944 408	54	0·147 443 393 000 124 918
25	0·068 260 830 092 650 425	55	0.150 173 826 203 830 935
26	0·070 991 263 296 356 442	56	0·152 904 259 407 536 952
27	0·073 721 696 500 062 459	57	0·155 634 692 611 242 969
28	0·076 452 129 703 768 476	58	0·158 365 125 814 948 986
29	0·079 182 562 907 474 493	59	0·161 095 559 018 655 003
30	0·081 912 996 111 180 51	60	0·163 825 992 222 361 02

Conversion of decimal parts of seconds of mean Sidereal time into mean Solar.

Sec.	Sec.
0·1	0·000 273 043 320 370 601 7
0·2	0·000 546 086 640 741 203 4
0·3	0·000 819 129 961 111 805 1
0·4	0·001 092 173 281 482 406 8
0·5	0·001 365 216 601 853 008 5
0·6	0·001 638 259 922 223 610 2
0·7	0·001 911 303 242 594 211 9
0·8	0·002 184 346 562 964 813 6
0·9	0·002 457 389 883 335 415 3
1·0	0·002 730 433 203 706 017

TABLE XLIV.

Complement of the Equable, Cyclical or Nabonassarian, year in mean Sidereal time, from one to 7000 years.

EPOCHS.

Æra Cyc.	A. M.	B. C.	Nab.	At Jerusalem. Mean midnight. h. m. s.	At Greenwich. Mean midnight. h. m. s.
0—1	1	4004	Mesore 10=April 25	0 0 0·000 000	April 25 0 0 23·127 116
				Mean noon. h. m. s.	Mean noon. h. m. s.
0—1	1	4004	Mesore 10=April 25	0 1 58·277 664	April 25 0 2 21·404 780

Æra Cyc.	Nab.	A. M.	A. D.	Nab.	At Jerusalem. Mean midnight. h. m. s.	At Greenwich. Mean midnight. h. m. s.
5808—5809	2549—2550	5805	1801	Mesore 10=May 4	3 32 49·493 124	May 4 3 33 12·620 240
					Mean noon. h. m. s.	Mean noon. h. m. s.
5808—5809	2549—2550	5805	1801	Mesore 10=May 4	3 34 47·770 788	May 4 3 35 10·897 904

Equable Years.	Days.	h.	m.	s.
1	..	23	59	2·694 471 956 622 96
2	1	23	58	5·388 943 913 245 92
3	2	23	57	8·083 415 869 868 88
4	3	23	56	10·777 887 826 491 84
5	4	23	55	13·472 359 783 114 8
6	5	23	54	16·166 831 739 737 76
7	6	23	53	18·861 303 696 360 72
8	7	23	52	21·555 775 652 983 68
9	8	23	51	24·250 247 609 606 64
10	9	23	50	26·944 719 566 229 6
20	19	23	40	53·889 439 132 459 2
30	29	23	31	20·834 158 698 688 8
40	39	23	21	47·778 878 264 918 4
50	49	23	12	14·723 597 831 148
60	59	23	2	41·668 317 397 377 6
70	69	22	53	8·613 036 963 607 2
80	79	22	43	35·557 756 529 836 8
90	89	22	34	2·502 476 096 066 4
100	99	22	24	29·447 195 662 296
200	199	20	48	58·894 391 324 592
300	299	19	13	28·341 586 986 888
400	399	17	37	57·788 782 649 184
500	499	16	2	27·235 978 311 48
600	599	14	26	56·683 173 973 776
700	699	12	51	26·130 369 636 072
800	799	11	15	55·577 565 298 368
900	899	9	40	25·024 760 960 664
1000	999	8	4	54·471 956 622 96
2000	1998	16	9	48·943 913 245 92
3000	2998	0	14	43·415 869 868 88
4000	3997	8	19	37·887 826 491 84
5000	4996	16	24	32·359 783 114 8
6000	5996	0	29	26·831 739 737 76
7000	6995	8	34	21·303 696 360 72

TABLE XLV.

Sum of mean Sidereal time in the mean Tropical year of the Fasti from one to 7000 years.

Years.	Days.	h.	m.	s.	th.
1	366	5	48	50	24
2	732	11	37	40	48
3	1 098	17	26	31	12
4	1 464	23	15	21	36
5	1 831	5	4	12	
6	2 197	10	53	2	24
7	2 563	16	41	52	48
8	2 929	22	30	43	12
9	3 296	4	19	33	36
10	3 662	10	8	24	
20	7 324	20	16	48	
30	10 987	6	25	12	
40	14 649	16	33	36	
50	18 312	2	42		
60	21 974	12	50	24	
70	25 636	22	58	48	
80	29 299	9	7	12	
90	32 961	19	15	36	
100	36 624	5	24		
200	73 248	10	48		
300	109 872	16	12		
400	146 496	21	36		
500	183 121	3			
600	219 745	8	24		
700	256 369	13	48		
800	292 993	19	12		
900	329 618	0	36		
1000	366 242	6			
2000	732 484	12			
3000	1 098 726	18			
4000	1 464 969				
5000	1 831 211	6			
6000	2 197 453	12			
7000	2 563 695	18			

TABLE XLVI.

Complement of the mean Julian year in mean Sidereal time, from one to 7000 years.

EPOCHS.

Cycle of leap-yr.	A. M.	B. C.	At Jerusalem. Mean midnight.	h.	m.	s.	At Greenwich. Mean midnight.	h.	m.	s.
2	1	4004	April 25	0	0	0·000 000	April 25	0	0	23·127 116
3	2	4003	April 25	23	59	2·694 472	April 25	23	59	25·821 588
4	3	4002	April 25	23	58	5·388 944	April 25	23	58	28·516 06
1	4	4001	April 25	0	1	4·638 743	April 25	0	1	27·765 86

Cycle of leap-yr.	A. M.	B. C.	At Jerusalem. Mean noon.	h.	m.	s.	At Greenwich. Mean noon.	h.	m.	s.
2	1	4004	April 25	0	1	58·277 664	April 25	0	2	21·404 78
3	2	4003	April 25	0	1	0·972 136	April 25	0	1	24·099 252
4	3	4002	April 25	0	0	3·666 608	April 25	0	0	26·793 724
1	4	4001	April 25	0	3	2·916 407	April 25	0	3	26·043 523

Cycle of leap-yr.	A. M.	A.D.	At Jerusalem. Mean midnight.	h.	m.	s.	At Greenwich. Mean midnight.	h.	m.	s.
2	5805	1801	April 24	2	53	23·939 851	April 24	2	53	47·066 967
3	5806	1802	April 24	2	52	26·634 323	April 24	2	52	49·761 439
4	5807	1803	April 24	2	51	29·328 795	April 24	2	51	52·455 911
1	5808	1804	April 24	2	54	28·578 594	April 24	2	54	51·705 71

Cycle of leap-yr.	A. M.	A.D.	At Jerusalem. Mean noon.	h.	m.	s.	At Greenwich. Mean noon.	h.	m.	s.
2	5805	1801	April 24	2	55	22·217 515	April 24	2	55	45·344 631
3	5806	1802	April 24	2	54	24·911 986	April 24	2	54	48·039 103
4	5807	1803	April 24	2	53	27·606 458	Aprii 24	2	53	50·733 575
1	5808	1804	April 24	2	56	26·856 258	April 24	2	56	49·983 374

Years.	Days.	h.	m.	s.
1	1	0	0	1·833 303 786 730 236
2	2	0	0	3·666 607 573 460 472
3	3	0	0	5·499 911 360 190 708
4	4	0	0	7·333 215 146 920 944
5	5	0	0	9·166 518 933 651 18
6	6	0	0	10·999 822 720 381 416
7	7	0	0	12·833 126 507 111 652
8	8	0	0	14·666 430 293 841 888
9	9	0	0	16·499 734 080 572 124
10	10	0	0	18·333 037 867 302 36
20	20	0	0	36·666 075 734 604 72
30	30	0	0	54·999 113 601 907 08
40	40	0	1	13·332 151 469 209 44
50	50	0	1	31·665 189 336 511 8
60	60	0	1	49·998 227 203 814 16
70	70	0	2	8·331 265 071 116 52
80	80	0	2	26·664 302 938 418 88
90	90	0	2	44·997 340 805 721 24
100	100	0	3	3·330 378 673 023 6
200	200	0	6	6·660 757 346 047 2
300	300	0	9	9·991 136 019 070 8
400	400	0	12	13·321 514 692 094 4
500	500	0	15	16·651 893 365 118
600	600	0	18	19·982 272 038 141 6
700	700	0	21	23·312 650 711 165 2
800	800	0	24	26·643 029 384 188 8
900	900	0	27	29·973 408 057 212 4
1000	1000	0	30	33·303 786 730 236
2000	2000	1	1	6·607 573 460 472
3000	3000	1	31	39·911 360 190 708
4000	4000	2	2	13·215 146 920 944
5000	5000	2	32	46·518 933 651 18
6000	6000	3	3	19·822 720 381 416
7000	7000	3	33	53·126 507 111 652

TABLE XLVII.

Complement of the mean Sidereal year of the Fasti, in mean Sidereal time, from one to 7000 years.

Years.	Days.	h.	m.	s.
1	1	0	0	3·337 969 401 947 148 817 8
2	2	0	0	6·675 938 803 894 297 635 6
3	3	0	0	10·013 908 205 841 446 453 4
4	4	0	0	13·351 877 607 788 595 271 2
5	5	0	0	16·689 847 009 735 744 089
6	6	0	0	20·027 816 411 682 892 906 8
7	7	0	0	23·365 785 813 630 041 724 6
8	8	0	0	26·703 755 215 577 190 542 4
9	9	0	0	30·041 724 617 524 339 360 2
10	10	0	0	33·379 694 019 471 488 178
20	20	0	1	6·759 388 038 942 976 356
30	30	0	1	40·139 082 058 414 464 534
40	40	0	2	13·518 776 077 885 952 712
50	50	0	2	46·898 470 097 357 440 890
60	60	0	3	20·278 164 116 828 929 068
70	70	0	3	53·657 858 136 300 417 246
80	80	0	4	27·037 552 155 771 905 424
90	90	0	5	0·417 246 175 243 393 602
100	100	0	5	33·796 940 194 714 881 78
200	200	0	11	7·593 880 389 429 763 56
300	300	0	16	41·390 820 584 144 645 34
400	400	0	22	15·187 760 778 859 527 12
500	500	0	27	48·984 700 973 574 408 9
600	600	0	33	22·781 641 168 289 290 68
700	700	0	38	56·578 581 363 004 172 46
800	800	0	44	30·375 521 557 719 054 24
900	900	0	50	4·172 461 752 433 936 02
1000	1000	0	55	37·969 401 947 148 817 8
2000	2000	1	51	15·938 803 894 297 635 6
3000	3000	2	46	53·908 205 841 446 453 4
4000	4000	3	42	31·877 607 788 595 271 2
5000	5000	4	38	9·847 009 735 744 089
6000	6000	5	33	47·816 411 682 892 906 8
7000	7000	6	29	25·785 813 630 041 724 6

TABLE XLVIII.

Increment or Decrement of the obliquity of the ecliptic, from one to 7000 mean Julian years. Epoch, A.D. 1750. Obliquity, A.D. 1750, 23° 28′ 17″·65. Annual Increment or Decrement, 0″·457. Secular correction, 0″·000 544 6 × κ centuries. Negative before A.D. 1750, positive after.

Years.	′	″
1	0	0·457
2	0	0·914
3	0	1·371
4	0	1·828
5	0	2·285
6	0	2·742
7	0	3·199
8	0	3·656
9	0	4·113
10	0	4·570
20	0	9·14
30	0	13·71
40	0	18·28
50	0	22·85
60	0	27·42
70	0	31·99
80	0	36·56
90	0	41·13
100	0	45·70
200	1	31·4
300	2	17·1
400	3	2·8
500	3	48·5
600	4	34·2
700	5	19·9
800	6	5·6
900	6	51·3
1000	7	37
2000	15	14
3000	22	51
4000	30	28
5000	38	5
6000	45	42
7000	53	19

Lunar Elements of the Phœnix Period. Mean Diurnal motion in longitude, from one mean solar day to 365.

Days.	Revs.	°	′	″	Mon.	Days.	Revs.	°	′	″
1	..	13	10	35·005 456 612 62	1	30	1	35	17	30·163 698 378 6
2	..	26	21	10·010 913 225 24	2	60	2	70	35	0·327 396 757 2
3	..	39	31	45·016 369 837 86	3	90	3	105	52	30·491 095 135 8
4	..	52	42	20·021 826 450 48	4	120	4	141	10	0·654 793 514 4
5	..	65	52	55·027 283 063 10	5	150	5	176	27	30·818 491 893
6	..	79	3	30·032 739 675 72	6	180	6	211	45	0·982 190 271 6
7	..	92	14	5·038 196 288 34	7	210	7	247	2	31·145 888 650 2
8	..	105	24	40·043 652 900 96	8	240	8	282	20	1·309 587 028 8
9	..	118	35	15·049 109 513 58	9	270	9	317	37	31·473 285 407 4
10	..	131	45	50·054 566 126 20	10	300	10	352	55	1·636 983 786
11	..	144	56	25·060 022 738 82	11	330	12	28	12	31·800 682 164 6
12	..	158	7	0·065 479 351 44	12	360	13	63	30	1·964 380 543 2
13	..	171	17	35·070 935 964 06		5		65	52	55·027 283 063 1
14	..	184	28	10·076 392 576 68		365	13	129	22	56·991 663 606 3
15	..	197	38	45·081 849 189 30						
16	..	210	49	20·087 305 801 92						
17	..	223	59	55·092 762 414 54						
18	..	237	10	30·098 219 027 16						
19	..	250	21	5·103 675 639 78						
20	..	263	31	40·109 132 252 40						
21	..	276	42	15·114 588 865 02						
22	..	289	52	50·120 045 477 64						
23	..	303	3	25·125 502 090 26						
24	..	316	14	0·130 958 702 88						
25	..	329	24	35·136 415 315 50						
26	..	342	35	10·141 871 928 12						
27	..	355	45	45·147 328 540 74						
28	1	8	56	20·152 785 153 36						
29	1	22	6	55·158 241 765 98						
30	1	35	17	30·163 698 378 60						
31	1	48	28	5·169 154 991 22						

Lunar Elements of the Phœnix Period. Mean Horary motion in longitude, from one hour of mean solar time to 24.

Hrs.	°	′
1	..	32·940 976 011 536 54
2	1	5·881 952 023 073 08
3	1	38·822 928 034 609 62
4	2	11·763 904 046 146 16
5	2	44·704 880 057 682 70
6	3	17·645 856 069 219 24
7	3	50·586 832 080 755 78
8	4	23·527 808 092 292 32
9	4	56·468 784 103 828 86
10	5	29·409 760 115 365 40
11	6	2·350 736 126 901 94
12	6	35·291 712 138 438 48
13	7	8·232 688 149 975 02
14	7	41·173 664 161 511 56
15	8	14·114 640 173 048 10
16	8	47·055 616 184 584 64
17	9	19·996 592 196 121 18
18	9	52·937 568 207 657 72
19	10	25·878 544 219 194 26
20	10	58·819 520 230 730 80
21	11	31·760 496 242 267 34
22	12	4·701 472 253 803 88
23	12	37·642 448 265 340 42
24	13	10·583 424 276 876 96

TABLE XLIX.—Part III.

Lunar Elements of the Phœnix Period. Mean Sexagesimal motion in longitude, from one minute of mean Solar time to 60.

Min.	′	Min.	′
1	0·549 016 266 858 942	31	17·019 504 272 627 202
2	1·098 032 533 717 884	32	17·568 520 539 486 144
3	1·647 048 800 576 826	33	18·117 536 806 345 086
4	2·196 065 067 435 768	34	18·666 553 073 204 028
5	2·745 081 334 294 710	35	19·215 569 340 062 970
6	3·294 097 601 153 652	36	19·764 585 606 921 912
7	3·843 113 868 012 594	37	20·313 601 873 780 854
8	4·392 130 134 871 536	38	20·862 618 140 639 796
9	4·941 146 401 730 478	39	21·411 634 407 498 738
10	5·490 162 668 589 420	40	21·960 650 674 357 680
11	6·039 178 935 448 362	41	22·509 666 941 216 622
12	6·588 195 202 307 304	42	23·058 683 208 075 564
13	7·137 211 469 166 246	43	23·607 699 474 934 506
14	7·686 227 736 025 188	44	24·156 715 741 793 448
15	8·235 244 002 884 130	45	24·705 732 008 652 390
16	8·784 260 269 743 072	46	25·254 748 275 511 332
17	9·333 276 536 602 014	47	25·803 764 542 370 274
18	9·882 292 803 460 956	48	26·352 780 809 229 216
19	10·431 309 070 319 898	49	26·901 797 076 088 158
20	10·980 325 337 178 840	50	27·450 813 342 947 100
21	11·529 341 604 037 782	51	27·999 829 609 806 042
22	12·078 357 870 896 724	52	28·548 845 876 664 984
23	12·627 374 137 755 666	53	29·097 862 143 523 926
24	13·176 390 404 614 608	54	29·646 878 410 382 868
25	13·725 406 671 473 550	55	30·195 894 677 241 810
26	14·274 422 938 332 492	56	30·744 910 944 100 752
27	14·823 439 205 191 434	57	31·293 927 210 959 694
28	15·372 455 472 050 376	58	31·842 943 477 818 636
29	15·921 471 738 909 318	59	32·391 959 744 677 578
30	16·470 488 005 768 260	60	32·940 976 011 536 520

TABLE XLIX.—Part IV.

Lunar Elements of the Phœnix Period. Mean Sexagesimal motion in longitude, from one second of mean Solar time to 60: and in decimal parts of one second of mean Solar time.

Sec.	′	Sec.	′
1	0·009 150 271 114 315 7	31	0·283 658 404 543 786 7
2	0·018 300 542 228 631 4	32	0·292 808 675 658 102 4
3	0·027 450 813 342 947 1	33	0·301 958 946 772 418 1
4	0·036 601 084 457 262 8	34	0·311 109 217 886 733 8
5	0·045 751 355 571 578 5	35	0·320 259 489 001 049 5
6	0·054 901 626 685 894 2	36	0·329 409 760 115 365 2
7	0·064 051 897 800 209 9	37	0·338 560 031 229 680 9
8	0·073 202 168 914 525 6	38	0·347 710 302 343 996 6
9	0·082 352 440 028 841 3	39	0·356 860 573 458 312 3
10	0·091 502 711 143 157 0	40	0·366 010 844 572 628 0
11	0·100 652 982 257 472 7	41	0·375 161 115 686 943 7
12	0·109 803 253 371 788 4	42	0·384 311 386 801 259 4
13	0·118 953 524 486 104 1	43	0·393 461 657 915 575 1
14	0·128 103 795 600 419 8	44	0·402 611 929 029 890 8
15	0·137 254 066 714 735 5	45	0·411 762 200 144 206 5
16	0·146 404 337 829 051 2	46	0·420 912 471 258 522 2
17	0·155 554 608 943 366 9	47	0·430 062 742 372 837 9
18	0·164 704 880 057 682 6	48	0·439 213 013 487 153 6
19	0·173 855 151 171 998 3	49	0·448 363 284 601 469 3
20	0·183 005 422 286 314 0	50	0·457 513 555 715 785 0
21	0·192 155 693 400 629 7	51	0·466 663 826 830 100 7
22	0·201 305 964 514 945 4	52	0·475 814 097 944 416 4
23	0·210 456 235 629 261 1	53	0·484 964 369 058 732 1
24	0·219 606 506 743 576 8	54	0·494 114 640 173 047 8
25	0·228 756 777 857 892 5	55	0·503 264 911 287 363 5
26	0·237 907 048 972 208 2	56	0·512 415 182 401 679 2
27	0·247 057 320 086 523 9	57	0·521 565 453 515 994 9
28	0·256 207 591 200 839 6	58	0·530 715 724 630 310 6
29	0·265 357 862 315 155 3	59	0·539 865 995 744 626 3
30	0·274 508 133 429 471 0	60	0·549 016 266 858 942 0

Mean motion in decimal parts of one second of mean Solar time.

Sec.	′
0·1	0·000 915 027 111 431 57
0·2	0·001 830 054 222 863 14
0·3	0·002 745 081 334 294 71
0·4	0·003 660 108 445 726 28
0·5	0·004 575 135 557 157 85
0·6	0·005 490 162 668 589 42
0·7	0·006 405 189 780 020 99
0·8	0·007 320 216 891 452 56
0·9	0·008 235 244 002 884 13
1·0	0·009 150 271 114 315 70

TABLE L.

Lunar Elements of the Phœnix Period. Mean motion of the Moon in longitude according to the Phœnix standard, from one mean Tropical year of the Fasti to 7000.

Years.	Revs.	°	′	″
1	13	132	34	28·121 735 470 707 195
2	26	265	8	56·243 470 941 414 390
3	40	37	43	24·365 206 412 121 585
4	53	170	17	52·486 941 882 828 780
5	66	302	52	20·608 677 353 535 975
6	80	75	26	48·730 412 824 243 170
7	93	208	1	16·852 148 294 950 365
8	106	340	35	44·973 883 765 657 560
9	120	113	10	13·095 619 236 364 755
10	133	245	44	41·217 354 707 071 95
20	267	131	29	22·434 709 414 143 90
30	401	17	14	3·652 064 121 215 85
40	534	262	58	44·869 418 828 287 80
50	668	148	43	26·086 773 535 359 75
60	802	34	28	7·304 128 242 431 70
70	935	280	12	48·521 482 949 503 65
80	1 069	165	57	29·738 837 656 575 60
90	1 203	51	42	10·956 192 363 647 55
100	1 336	297	26	52·173 547 070 719 5
200	2 673	234	53	44·347 094 141 439
300	4 010	172	20	36·520 641 212 158 5
400	5 347	109	47	28·694 188 282 878
500	6 684	47	14	20·867 735 353 597 5
600	8 020	344	41	13·041 282 424 317
700	9 357	282	8	5·214 829 495 036 5
800	10 694	219	34	57·388 376 565 756
900	12 031	157	1	49·561 923 636 475 5
1000	13 368	94	28	41·735 470 707 195
2000	26 736	188	57	23·470 941 414 39
3000	40 104	283	26	5·206 412 121 585
4000	53 473	17	54	46·941 882 828 780
5000	66 841	112	23	28·677 353 535 975
6000	80 209	206	52	10·412 824 243 17
7000	93 577	301	20	52·148 294 950 365

TABLE LI.

Lunar Elements of the Phœnix Period. Mean motion of the Moon in longitude according to the Phœnix standard, from one mean Julian year to 7000.

Years.	Revs.	°	′	″
1	13	132	40	35·743 027 759 455
2	26	265	21	11·486 055 518 910
3	40	38	1	47·229 083 278 365
4	53	170	42	22·972 111 037 820
5	66	303	22	58·715 138 797 275
6	80	76	3	34·458 166 556 730
7	93	208	44	10·201 194 316 185
8	106	341	24	45·944 222 075 640
9	120	114	5	21·687 249 835 095
10	133	246	45	57·430 277 594 550
20	267	133	31	54·860 555 189 10
30	401	20	17	52·290 832 783 65
40	534	267	3	49·721 110 378 20
50	668	153	49	47·151 387 972 75
60	802	40	35	44·581 665 567 30
70	935	287	21	42·011 943 161 85
80	1 069	174	7	39·442 220 756 40
90	1 203	60	53	36·872 498 350 95
100	1 336	307	39	34·302 775 945 50
200	2 673	255	19	8·605 551 891 0
300	4 010	202	58	42·908 327 836 5
400	5 347	150	38	17·211 103 782 0
500	6 684	98	17	51·513 879 727 5
600	8 021	45	57	25·816 655 673 0
700	9 357	353	37	0·119 431 618 5
800	10 694	301	16	34·422 207 564 0
900	12 031	248	56	8·724 983 509 5
1000	13 368	196	35	43·027 759 455 0
2000	26 737	33	11	26·055 518 910
3000	40 105	229	47	9·083 278 365
4000	53 474	66	22	52·111 037 820
5000	66 842	262	58	35·138 797 275
6000	80 211	99	34	18·166 556 730
7000	93 579	296	10	1·194 316 185

TABLE LII.

Lunar Elements of the Phœnix Period. Sum of mean Solar time, from one to thirteen months of the Phœnix standard.

Mon.	Days.	h.	m.	s.	Days.
1	29	12	44	4·113 842 173 35	29·530 603 169 469 598 958 222
2	59	1	28	8·227 684 346 70	59·061 206 338 939 197 916 444
3	88	14	12	12·341 526 520 05	88·591 809 508 408 796 874 666
4	118	2	56	16·455 368 693 40	118·122 412 677 878 395 832 888
5	147	15	40	20·569 210 866 75	147·653 015 847 347 994 791 110
6	177	4	24	24·683 053 040 10	177·183 619 016 817 593 749 332
7	206	17	8	28·796 895 213 45	206·714 222 186 287 192 707 554
8	236	5	52	32·910 737 386 80	236·244 825 355 756 791 665 776
9	265	18	36	37·024 579 560 15	265·775 428 525 226 390 623 998
10	295	7	20	41·138 421 733 50	295·306 031 694 695 989 582 220
11	324	20	4	45·252 263 906 85	324·836 634 864 165 588 540 442
12	354	8	48	49·366 106 080 2	354·367 238 033 635 187 498 664
13	383	21	32	53·479 948 253 55	383·897 841 203 104 786 456 886

	d.	h.	m.	s.		d.	h.	m.	s.
Epact on the Equable year	365	0	0	0	=	10	15	11	10·633 893 919 8
On the mean Tropical	365	5	48	50·4	=	10	21	0	1·033 893 919 8
On the mean Julian	365	6	0	0	=	10	21·	11	10·633 893 919 8
On the mean Sidereal	365	6	9	9·567 454 798 331	=	10	21	20	20·201 348 718 131
On the Julian of ..	366	0	0	0	=	11	15	11	10·633 893 919 8

TABLE LIII.

Cycle of the Dominical or Sunday Letter in the Julian year.

January.

Day	A	B	C	D	E	F	G
1	S	sa	fr	th	w	tu	m
2	m	S	sa	fr	th	w	tu
3	tu	m	S	sa	fr	th	w
4	w	tu	m	S	sa	fr	th
5	th	w	tu	m	S	sa	fr
6	fr	th	w	tu	m	S	sa
7	sa	fr	th	w	tu	m	S
8	S	sa	fr	th	w	tu	m
9	m	S	sa	fr	th	w	tu
10	tu	m	S	sa	fr	th	w
11	w	tu	m	S	sa	fr	th
12	th	w	tu	m	S	sa	fr
13	fr	th	w	tu	m	S	sa
14	sa	fr	th	w	tu	m	S
15	S	sa	fr	th	w	tu	m
16	m	S	sa	fr	th	w	tu
17	tu	m	S	sa	fr	th	w
18	w	tu	m	S	sa	fr	th
19	th	w	tu	m	S	sa	fr
20	fr	th	w	tu	m	S	sa
21	sa	fr	th	w	tu	m	S
22	S	sa	fr	th	w	tu	m
23	m	S	sa	fr	th	w	tu
24	tu	m	S	sa	fr	th	w
25	w	tu	m	S	sa	fr	th
26	th	w	tu	m	S	sa	fr
27	fr	th	w	tu	m	S	sa
28	sa	fr	th	w	tu	m	S
29	S	sa	fr	th	w	tu	m
30	m	S	sa	fr	th	w	tu
31	tu	m	S	sa	fr	th	w

February.

Day	A	B	C	D	E	F	G
1	w	tu	m	S	sa	fr	th
2	th	w	tu	m	S	sa	fr
3	fr	th	w	tu	m	S	sa
4	sa	fr	th	w	tu	m	S
5	S	sa	fr	th	w	tu	m
6	m	S	sa	fr	th	w	tu
7	tu	m	S	sa	fr	th	w
8	w	tu	m	S	sa	fr	th
9	th	w	tu	m	S	sa	fr
10	fr	th	w	tu	m	S	sa
11	sa	fr	th	w	tu	m	S
12	S	sa	fr	th	w	tu	m
13	m	S	sa	fr	th	w	tu
14	tu	m	S	sa	fr	th	w
15	w	tu	m	S	sa	fr	th
16	th	w	tu	m	S	sa	fr
17	fr	th	w	tu	m	S	sa
18	sa	fr	th	w	tu	m	S
19	S	sa	fr	th	w	tu	m
20	m	S	sa	fr	th	w	tu
21	tu	m	S	sa	fr	th	w
22	w	tu	m	S	sa	fr	th
23	th	w	tu	m	S	sa	fr
24	fr	th	w	tu	m	S	sa
25	sa	fr	th	w	tu	m	S
26	S	sa	fr	th	w	tu	m
27	m	S	sa	fr	th	w	tu
28	tu	m	S	sa	fr	th	w
29	w	tu	m	S	sa	fr	th

March.

Day	A	B	C	D	E	F	G
1	w	tu	m	S	sa	fr	th
2	th	w	tu	m	S	sa	fr
3	fr	th	w	tu	m	S	sa
4	sa	fr	th	w	tu	m	S
5	S	sa	fr	th	w	tu	m
6	m	S	sa	fr	th	w	tu
7	tu	m	S	sa	fr	th	w
8	w	tu	m	S	sa	fr	th
9	th	w	tu	m	S	sa	fr
10	fr	th	w	tu	m	S	sa
11	sa	fr	th	w	tu	m	S
12	S	sa	fr	th	w	tu	m
13	m	S	sa	fr	th	w	tu
14	tu	m	S	sa	fr	th	w
15	w	tu	m	S	sa	fr	th
16	th	w	tu	m	S	sa	fr
17	fr	th	w	tu	m	S	sa
18	sa	fr	th	w	tu	m	S
19	S	sa	fr	th	w	tu	m
20	m	S	sa	fr	th	w	tu
21	tu	m	S	sa	fr	th	w
22	w	tu	m	S	sa	fr	th
23	th	w	tu	m	S	sa	fr
24	fr	th	w	tu	m	S	sa
25	sa	fr	th	w	tu	m	S
26	S	sa	fr	th	w	tu	m
27	m	S	sa	fr	th	w	tu
28	tu	m	S	sa	fr	th	w
29	w	tu	m	S	sa	fr	th
30	th	w	tu	m	S	sa	fr
31	fr	th	w	tu	m	S	sa

April.

Day	A	B	C	D	E	F	G
1	sa	fr	th	w	tu	m	S
2	S	sa	fr	th	w	tu	m
3	m	S	sa	fr	th	w	tu
4	tu	m	S	sa	fr	th	w
5	w	tu	m	S	sa	fr	th
6	th	w	tu	m	S	sa	fr
7	fr	th	w	tu	m	S	sa
8	sa	fr	th	w	tu	m	S
9	S	sa	fr	th	w	tu	m
10	m	S	sa	fr	th	w	tu
11	tu	m	S	sa	fr	th	w
12	w	tu	m	S	sa	fr	th
13	th	w	tu	m	S	sa	fr
14	fr	th	w	tu	m	S	sa
15	sa	fr	th	w	tu	m	S
16	S	sa	fr	th	w	tu	m
17	m	S	sa	fr	th	w	
18	tu	m	S	sa	fr	th	w
19	w	tu	m	S	sa	fr	th
20	th	w	tu	m	S	sa	fr
21	fr	th	w	tu	m	S	sa
22	sa	fr	th	w	tu	m	S
23	S	sa	fr	th	w	tu	m
24	m	S	sa	fr	th	w	tu
25	tu	m	S	sa	fr	th	w
26	w	tu	m	S	sa	fr	th
27	th	w	tu	m	S	sa	fr
28	fr	th	w	tu	m	S	sa
29	sa	fr	th	w	tu	m	S
30	S	sa	fr	th	w	tu	m

May.

Day	A	B	C	D	E	F	G
1	m	S	sa	fr	th	w	tu
2	tu	m	S	sa	fr	th	w
3	w	tu	m	S	sa	fr	th
4	th	w	tu	m	S	sa	fr
5	fr	th	w	tu	m	S	sa
6	sa	fr	th	w	tu	m	S
7	S	sa	fr	th	w	tu	m
8	m	S	sa	fr	th	w	tu
9	tu	m	S	sa	fr	th	w
10	w	tu	m	S	sa	fr	th
11	th	w	tu	m	S	sa	fr
12	fr	th	w	tu	m	S	sa
13	sa	fr	th	w	tu	m	S
14	S	sa	fr	th	w	tu	m
15	m	S	sa	fr	th	w	tu
16	tu	m	S	sa	fr	th	w
17	w	tu	m	S	sa	fr	th
18	th	w	tu	m	S	sa	fr
19	fr	th	w	tu	m	S	sa
20	sa	fr	th	w	tu	m	S
21	S	sa	fr	th	w	tu	m
22	m	S	sa	fr	th	w	tu
23	tu	m	S	sa	fr	th	w
24	w	tu	m	S	sa	fr	th
25	th	w	tu	m	S	sa	fr
26	fr	th	w	tu	m	S	sa
27	sa	fr	th	w	tu	m	S
28	S	sa	fr	th	w	tu	m
29	m	S	sa	fr	th	w	tu
30	tu	m	S	sa	fr	th	w
31	w	tu	m	S	sa	fr	th

June.

Day	A	B	C	D	E	F	G
1	th	w	tu	m	S	sa	fr
2	fr	th	w	tu	m	S	sa
3	sa	fr	th	w	tu	m	S
4	S	sa	fr	th	w	tu	m
5	m	S	sa	fr	th	w	tu
6	tu	m	S	sa	fr	th	w
7	w	tu	m	S	sa	fr	th
8	th	w	tu	m	S	sa	fr
9	fr	th	w	tu	m	S	sa
10	sa	fr	th	w	tu	m	S
11	S	sa	fr	th	w	tu	m
12	m	S	sa	fr	th	w	tu
13	tu	m	S	sa	fr	th	w
14	w	tu	m	S	sa	fr	th
15	th	w	tu	m	S	sa	fr
16	fr	th	w	tu	m	S	sa
17	sa	fr	th	w	tu	m	S
18	S	sa	fr	th	w	tu	m
19	m	S	sa	fr	th	w	tu
20	tu	m	S	sa	fr	th	w
21	w	tu	m	S	sa	fr	th
22	th	w	tu	m	S	sa	fr
23	fr	th	w	tu	m	S	sa
24	sa	fr	th	w	tu	m	S
25	S	sa	fr	th	w	tu	m
26	m	S	sa	fr	th	w	tu
27	tu	m	S	sa	fr	th	w
28	w	tu	m	S	sa	fr	th
29	th	w	tu	m	S	sa	fr
30	fr	th	w	tu	m	S	sa

TABLE LIII. continued.

July.

	A	B	C	D	E	F	G
1	sa	fr	th	w	tu	m	S
2	S	sa	fr	th	w	tu	m
3	m	S	sa	fr	th	w	tu
4	tu	m	S	sa	fr	th	w
5	w	tu	m	S	sa	fr	th
6	th	w	tu	m	S	sa	fr
7	fr	th	w	tu	m	S	sa
8	sa	fr	th	w	tu	m	S
9	S	sa	fr	th	w	tu	m
10	m	S	sa	fr	th	w	tu
11	tu	m	S	sa	fr	th	w
12	w	tu	m	S	sa	fr	th
13	th	w	tu	m	S	sa	fr
14	fr	th	w	tu	m	S	sa
15	sa	fr	th	w	tu	m	S
16	S	sa	fr	th	w	tu	m
17	m	S	sa	fr	th	w	tu
18	tu	m	S	sa	fr	th	w
19	w	tu	m	S	sa	fr	th
20	th	w	tu	m	S	sa	fr
21	fr	th	w	tu	m	S	sa
22	sa	fr	th	w	tu	m	S
23	S	sa	fr	th	w	tu	m
24	m	S	sa	fr	th	w	tu
25	tu	m	S	sa	fr	th	w
26	w	tu	m	S	sa	fr	th
27	th	w	tu	m	S	sa	fr
28	fr	th	w	tu	m	S	sa
29	sa	fr	th	w	tu	m	S
30	S	sa	fr	th	w	tu	m
31	m	S	sa	fr	th	w	tu

August.

	A	B	C	D	E	F	G
1	tu	m	S	sa	fr	th	w
2	w	tu	m	S	sa	fr	th
3	th	w	tu	m	S	sa	fr
4	fr	th	w	tu	m	S	sa
5	sa	fr	th	w	tu	m	S
6	S	sa	fr	th	w	tu	m
7	m	S	sa	fr	th	w	tu
8	tu	m	S	sa	fr	th	w
9	w	tu	m	S	sa	fr	th
10	th	w	tu	m	S	sa	fr
11	fr	th	w	tu	m	S	sa
12	sa	fr	th	w	tu	m	S
13	S	sa	fr	th	w	tu	m
14	m	S	sa	fr	th	w	tu
15	tu	m	S	sa	fr	th	w
16	w	tu	m	S	sa	fr	th
17	th	w	tu	m	S	sa	fr
18	fr	th	w	tu	m	S	sa
19	sa	fr	th	w	tu	m	S
20	S	sa	fr	th	w	tu	m
21	m	S	sa	fr	th	w	tu
22	tu	m	S	sa	fr	th	w
23	w	tu	m	S	sa	fr	th
24	th	w	tu	m	S	sa	fr
25	fr	th	w	tu	m	S	sa
26	sa	fr	th	w	tu	m	S
27	S	sa	fr	th	w	tu	m
28	m	S	sa	fr	th	w	tu
29	tu	m	S	sa	fr	th	w
30	w	tu	m	S	sa	fr	th
31	th	w	tu	m	S	sa	fr

September.

	A	B	C	D	E	F	G
1	fr	th	w	tu	m	S	sa
2	sa	fr	th	w	tu	m	S
3	S	sa	fr	th	w	tu	m
4	m	S	sa	fr	th	w	tu
5	tu	m	S	sa	fr	th	w
6	w	tu	m	S	sa	fr	th
7	th	w	tu	m	S	sa	fr
8	fr	th	w	tu	m	S	sa
9	sa	fr	th	w	tu	m	S
10	S	sa	fr	th	w	tu	m
11	m	S	sa	fr	th	w	tu
12	tu	m	S	sa	fr	th	w
13	w	tu	m	S	sa	fr	th
14	th	w	tu	m	S	sa	fr
15	fr	th	w	tu	m	S	sa
16	sa	fr	th	w	tu	m	S
17	S	sa	fr	th	w	tu	m
18	m	S	sa	fr	th	w	tu
19	tu	m	S	sa	fr	th	w
20	w	tu	m	S	sa	fr	th
21	th	w	tu	m	S	sa	fr
22	fr	th	w	tu	m	S	sa
23	sa	fr	th	w	tu	m	S
24	S	sa	fr	th	w	tu	m
25	m	S	sa	fr	th	w	tu
26	tu	m	S	sa	fr	th	w
27	w	tu	m	S	sa	fr	th
28	th	w	tu	m	S	sa	fr
29	fr	th	w	tu	m	S	sa
30	sa	fr	th	w	tu	m	S

October.

	A	B	C	D	E	F	G
1	S	sa	fr	th	w	tu	m
2	m	S	sa	fr	th	w	tu
3	tu	m	S	sa	fr	th	w
4	w	tu	m	S	sa	fr	th
5	th	w	tu	m	S	sa	fr
6	fr	th	w	tu	m	S	sa
7	sa	fr	th	w	tu	m	S
8	S	sa	fr	th	w	tu	m
9	m	S	sa	fr	th	w	tu
10	tu	m	S	sa	fr	th	w
11	w	tu	m	S	sa	fr	th
12	th	w	tu	m	S	sa	fr
13	fr	th	w	tu	m	S	sa
14	sa	fr	th	w	tu	m	S
15	S	sa	fr	th	w	tu	m
16	m	S	sa	fr	th	w	tu
17	tu	m	S	sa	fr	th	w
18	w	tu	m	S	sa	fr	th
19	th	w	tu	m	S	sa	fr
20	fr	th	w	tu	m	S	sa
21	sa	fr	th	w	tu	m	S
22	S	sa	fr	th	w	tu	m
23	m	S	sa	fr	th	w	tu
24	tu	m	S	sa	fr	th	w
25	w	tu	m	S	sa	fr	th
26	th	w	tu	m	S	sa	fr
27	fr	th	w	tu	m	S	sa
28	sa	fr	th	w	tu	m	S
29	S	sa	fr	th	w	tu	m
30	m	S	sa	fr	th	w	tu
31	tu	m	S	sa	fr	th	w

November.

	A	B	C	D	E	F	G
1	w	tu	m	S	sa	fr	th
2	th	w	tu	m	S	sa	fr
3	fr	th	w	tu	m	S	sa
4	sa	fr	th	w	tu	m	S
5	S	sa	fr	th	w	tu	m
6	m	S	sa	fr	th	w	tu
7	tu	m	S	sa	fr	th	w
8	w	tu	m	S	sa	fr	th
9	th	w	tu	m	S	sa	fr
10	fr	th	w	tu	m	S	sa
11	sa	fr	th	w	tu	m	S
12	S	sa	fr	th	w	tu	m
13	m	S	sa	fr	th	w	tu
14	tu	m	S	sa	fr	th	w
15	w	tu	m	S	sa	fr	th
16	th	w	tu	m	S	sa	fr
17	fr	th	w	tu	m	S	sa
18	sa	fr	th	w	tu	m	S
19	S	sa	fr	th	w	tu	m
20	m	S	sa	fr	th	w	tu
21	tu	m	S	sa	fr	th	w
22	w	tu	m	S	sa	fr	th
23	th	w	tu	m	S	sa	fr
24	fr	th	w	tu	m	S	sa
25	sa	fr	th	w	tu	m	S
26	S	sa	fr	th	w	tu	m
27	m	S	sa	fr	th	w	tu
28	tu	m	S	sa	fr	th	w
29	w	tu	m	S	sa	fr	th
30	th	w	tu	m	S	sa	fr

December.

	A	B	C	D	E	F	G
1	fr	th	w	tu	m	S	sa
2	sa	fr	th	w	tu	m	S
3	S	sa	fr	th	w	tu	m
4	m	S	sa	fr	th	w	tu
5	tu	m	S	sa	fr	th	w
6	w	tu	m	S	sa	fr	th
7	th	w	tu	m	S	sa	fr
8	fr	th	w	tu	m	S	sa
9	sa	fr	th	w	tu	m	S
10	S	sa	fr	th	w	tu	m
11	m	S	sa	fr	th	w	tu
12	tu	m	S	sa	fr	th	w
13	w	tu	m	S	sa	fr	th
14	th	w	tu	m	S	sa	fr
15	fr	th	w	tu	m	S	sa
16	sa	fr	th	w	tu	m	S
17	S	sa	fr	th	w	tu	m
18	m	S	sa	fr	th	w	tu
19	tu	m	S	sa	fr	th	w
20	w	tu	m	S	sa	fr	th
21	th	w	tu	m	S	sa	fr
22	fr	th	w	tu	m	S	sa
23	sa	fr	th	w	tu	m	S
24	S	sa	fr	th	w	tu	m
25	m	S	sa	fr	th	w	tu
26	tu	m	S	sa	fr	th	w
27	w	tu	m	S	sa	fr	th
28	th	w	tu	m	S	sa	fr
29	fr	th	w	tu	m	S	sa
30	sa	fr	th	w	tu	m	S
31	S	sa	fr	th	w	tu	m

TABLE LIV.

Intervals from the first day of one month to the first day of any other in the Julian year, whether of 365 or of 366 days.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.
January *	365	31	59	90	120	151	181	212	243	273	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March . .	306	337	365	31	61	92	122	153	184	214	245	275
April . . .	275	306	334	365	30	61	91	122	153	183	214	244
May . . .	245	276	304	335	365	31	61	92	123	153	184	214
June . . .	214	245	273	304	334	365	30	61	92	122	153	183
July . . .	184	215	243	274	304	335	365	31	62	92	123	153
August . .	153	184	212	243	273	304	334	365	31	61	92	122
September	122	153	181	212	242	273	303	334	365	30	61	91
October . .	92	123	151	182	212	243	273	304	335	365	31	61
November	61	92	120	151	181	212	242	273	304	334	365	30
December	31	62	90	121	151	182	212	243	274	304	335	365

* The required interval is found at the angle of intersection between the vertical line drawn from one of the months in question, and the horizontal line drawn from the other.

In leap-year a day extra must be given to these numbers after Feb. 28.